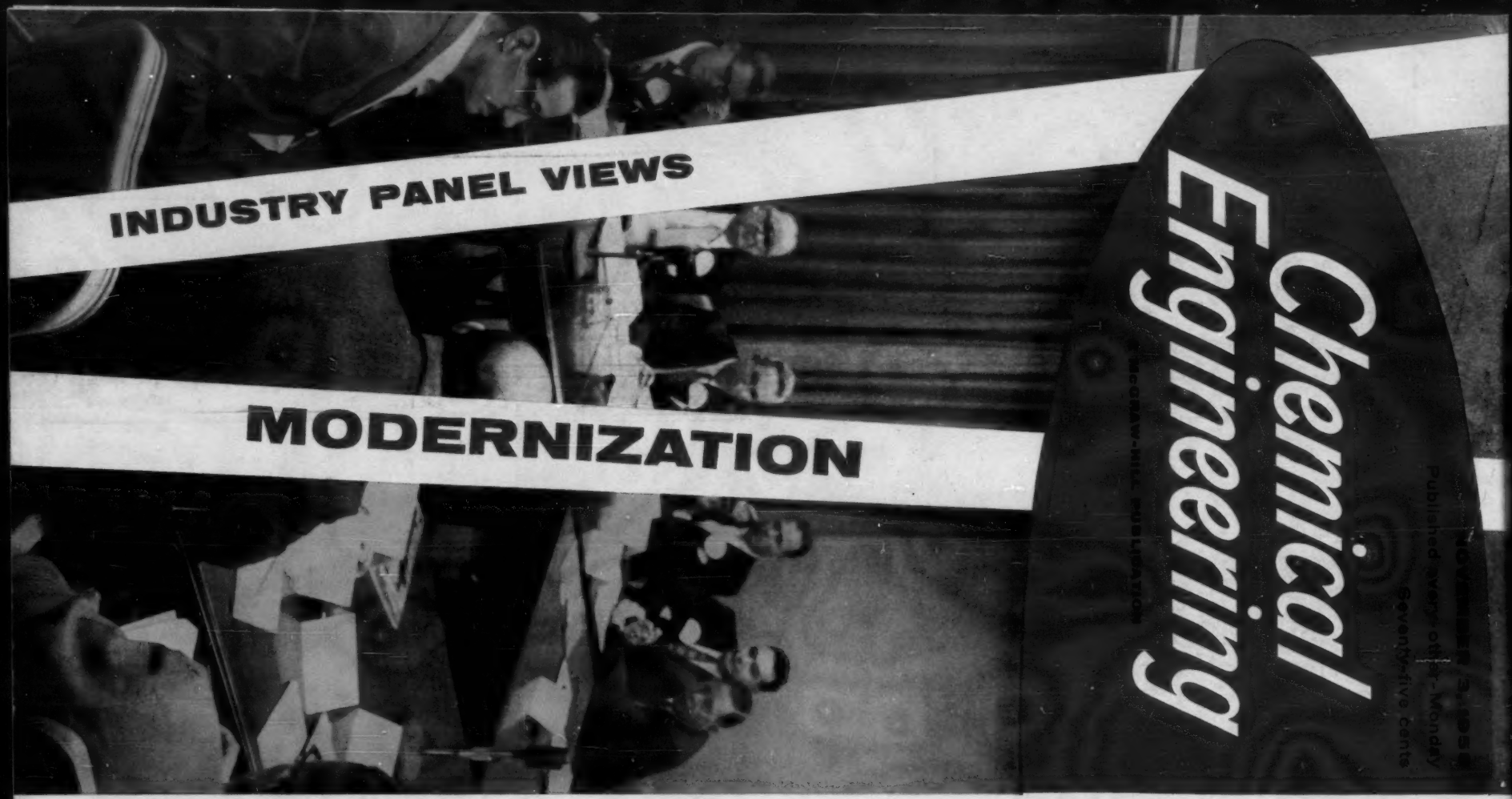

PLAN '59

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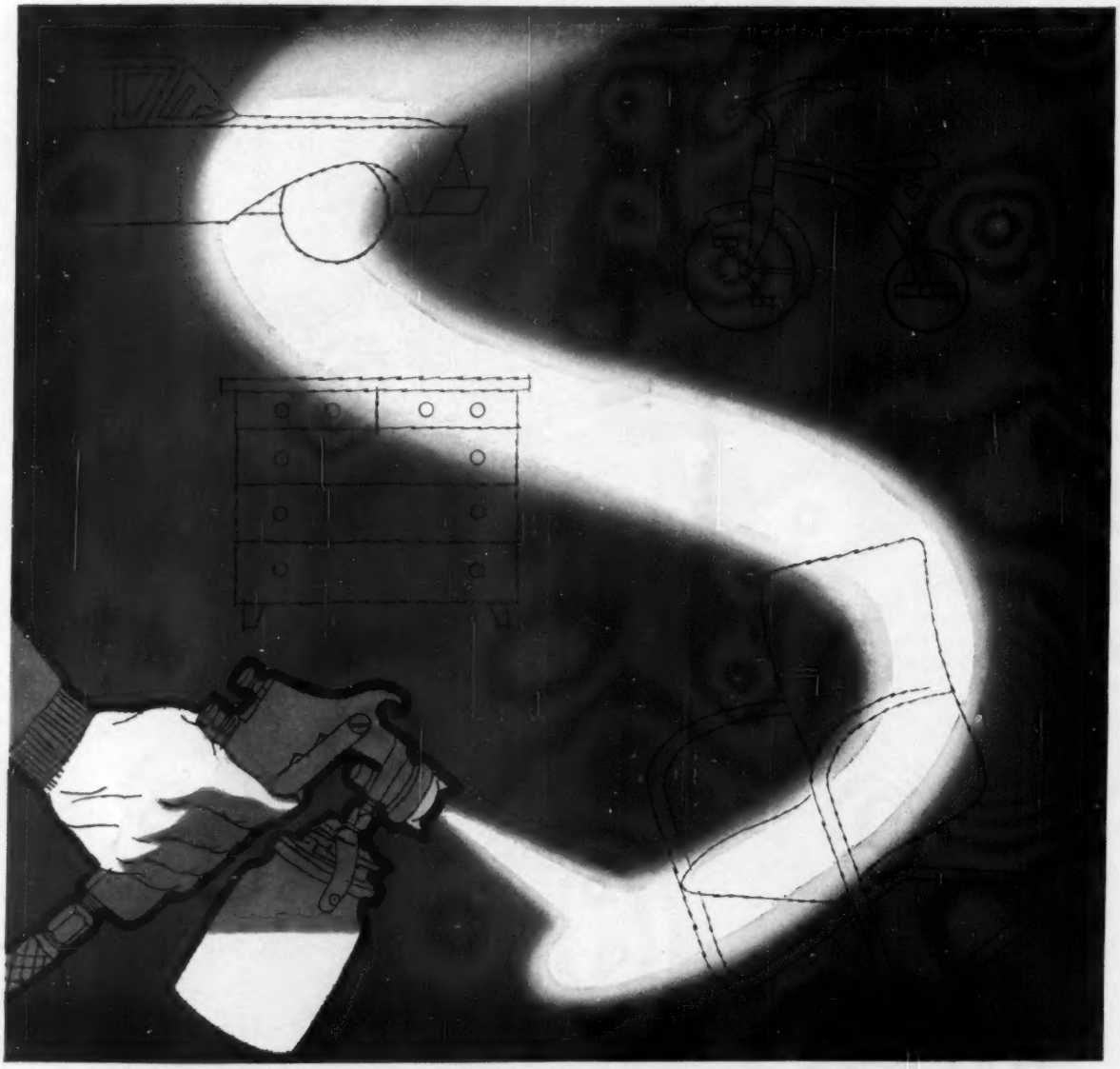
A SPECIAL REPORT FROM McGRAW-HILL TO AMERICA'S BUSINESS EXECUTIVES

McGraw-Hill's 34 business publications join in a major editorial effort to show why and how American industry must modernize now. This is PLAN '59

As its part in this coordinated program, Chemical Engineering presents a five-part, 32-page special report for the chemical process industries



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In surface coating formulations, ethyl amyl ketone (EAK) teams up with low-boiling MEK and medium-boiling MIBK to provide better flow and gloss and aids in eliminating dry overspray.

EAK's slow evaporation rate in surface coating formulations contributes to excellent flow-out, helps minimize pinholing and bubbling in the film. It also possesses excellent blush resistance, good diluent tolerance and high solvency.

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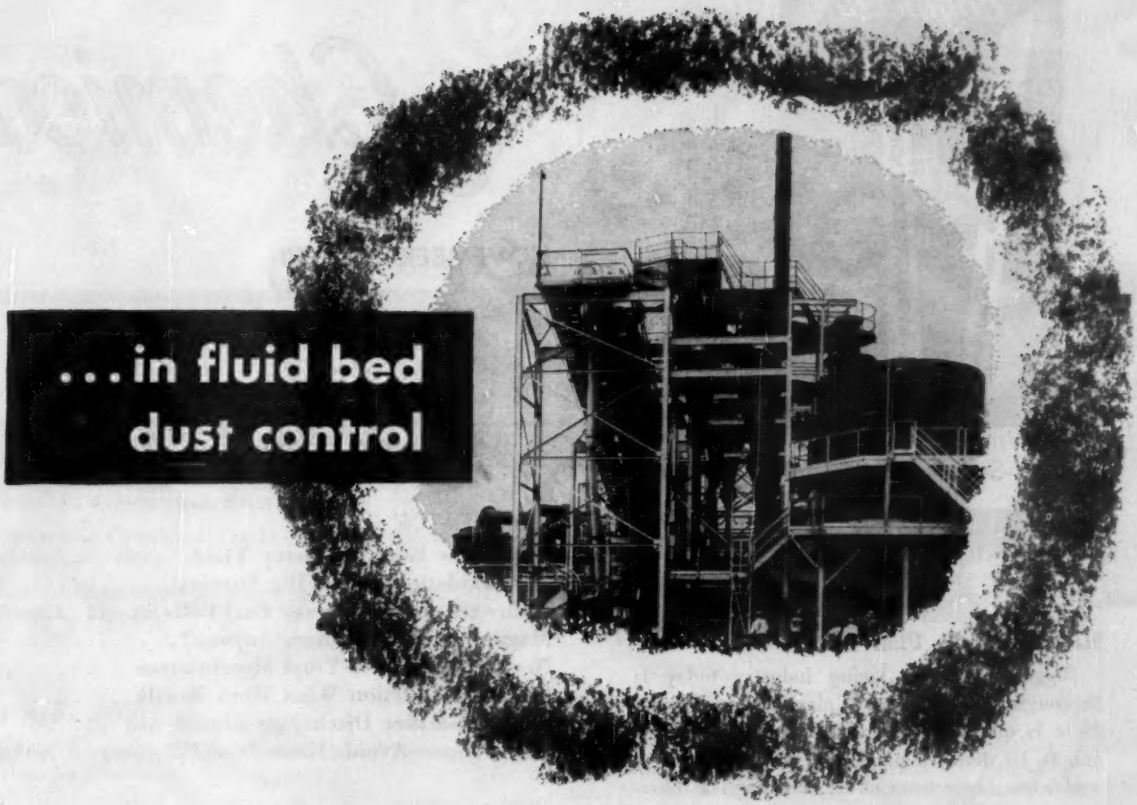

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DUCLONE high efficiency cyclone dust collectors are designed and constructed to take unusual service conditions in stride. That's why they have gained wide acceptance in fluid bed processes, such as the one illustrated for pyrite roasting to produce sulfur dioxide for manufacture of sulfuric acid. A special refractory lined primary Duclone and stainless steel secondary Duclones were supplied by Ducon to insure continuous operation under the inherent high temperature and corrosive conditions of the process.

High efficiency Duclones are available in a wide range of capacities and in multiple units and special materials to meet a wide variety of dry dust control applications.

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Chemical

NOVEMBER 3, 1958

Twenty-Second of Twenty-Six Issues

22/26

Modernization: Plan '59

Biggest challenge facing industry today is thorough modernization of plant and equipment. Here is our appraisal of the economics of the job to be done; a panel-in-print tells you why and when; how team effort can diagnose obsolescence; what's new in equipment; case histories to show how updating pays off. Plan '59 is designed to help you, your company, your community and your country. (p. 113)

New use for liquid-liquid extraction

Traditional way of separating columbium and tantalum—fractional crystallization—can be bypassed. See how solvent extraction process is now working on a commercial scale to separate these two strategic metals. (p. 103)

For your reports: the right pronoun

If all technical authors acknowledged their own conclusions there would be far less chance of misinterpretation. So if you want accuracy in your own written reports, forget your modesty and use "I" and "we." (p. 147)

How to get fast repair jobs

Here's a new wrinkle in repairing and stretching the life of corroded equipment. New plastic metals can cut costly downtime. They've been proved on big jobs as well as small. (p. 126)

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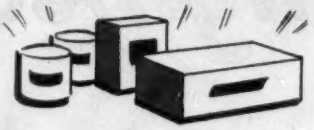
or a New Plant, or 

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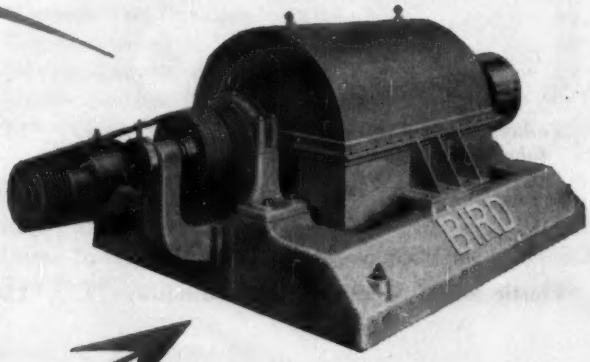

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Chemical Engineering

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NOV. 3, 1958

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At Wood River, Ill., Shell boasts first-time use of rotating disk contactors for propane deasphalting. New setup will key process improvements right down the line.

Refiners should prepare to change yield patterns.... 66

A look at the next eight years presages a bigger share of the market for middle distillates and fuel oil. Gasoline's share in the U. S. and Canada will slide to 40%.

Here are profitable ideas on modernization..... 113

In this unique and exclusive feature article, you'll find advice from the experts, helpful new equipment developments and how-to-do-it tips from case histories.

Repair with plastic metals to slash downtime..... 150

Among materials now gaining wider attention for fast repair jobs are plastic metals. They're being used on large vessels—sometimes without process interruption.

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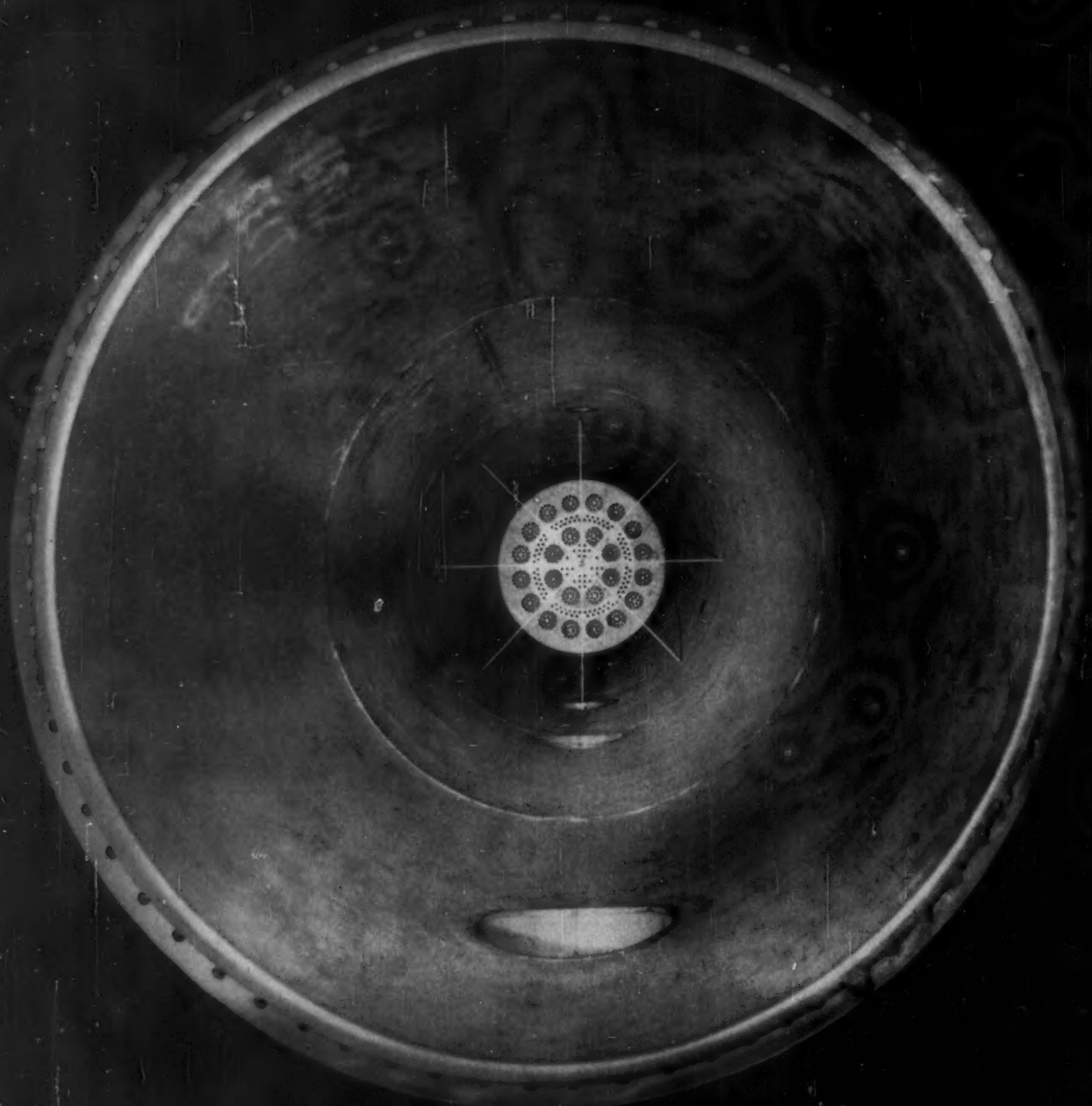
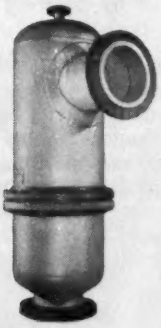
Working with Stainless Steel Is a Talent at...

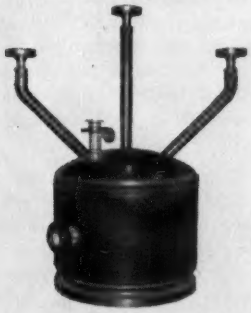


Vulcan manufacturing

Copper...
was used in the fabrication
of these bubble cap type trays



Hastelloy...
another unusual alloy was used to fabricate
this high-pressure entrainment separator



Monel-clad, too!
High-pressure reactor head of
Monel-clad carbon steel

The fractionating tower shown at the left is one of thousands of process components fabricated in stainless steel by Vulcan Manufacturing since Vulcan built the first stainless steel equipment for the chemical industry in 1931. This fact is important to you in that it suggests an unusual depth of experience in working with a metal that has contributed so substantially to advances in process techniques.

For example, Vulcan offers you reliable knowledge in the fabrication of stainless and stainless-clad as well as stainless lining or facing of carbon steel. We assure you of rigid quality control... use of the latest fabricating techniques... and the thorough testing of completed units.

It is this combination of skill and care in manufacture that has enabled Vulcan to become a leading producer of stainless steel components and to achieve a record output exceeding two million pounds of stainless steel equipment in 1957.

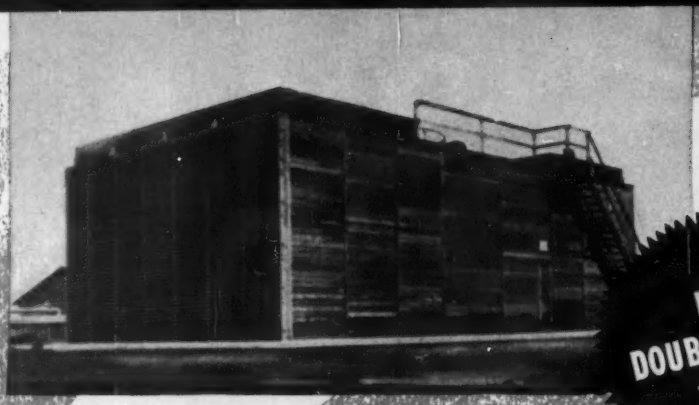
When your needs call for towers, heat exchangers or any vessel or part fabricated in any one of the 12 or more types of stainless steel—rely on the talent at Vulcan Manufacturing.

Vulcan manufacturing

120 Sycamore Street, Cincinnati 2, Ohio, Dunbar 1-1400

Designers and builders of process equipment

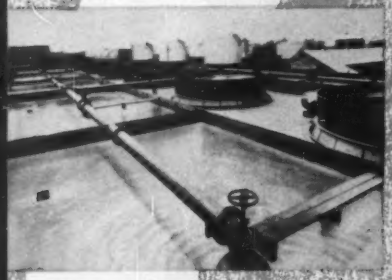
VUL-602



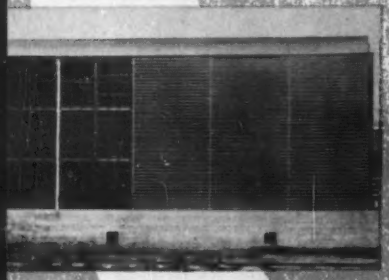
20 Years

First DOUBLE-FLOW 1938

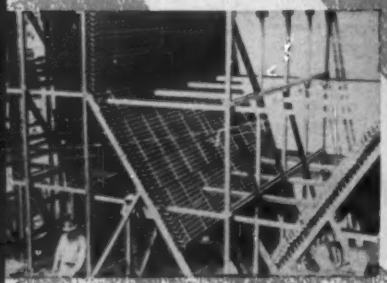
Highlights of Progress
in Double-Flow Design Down Through the Years



The original single-elevation fan deck (left) has been replaced by the more efficient elevated deck with heavy unitized steel equipment supports; the modern velocity recovery fan stack is an important, functional part of Double-Flow cooling towers.



The full-height louvered face remains but new, broad louvers on wide centers open it up for maximum air passage with little draft loss; they also prevent restriction of air travel by ice formation.



Drift eliminators in the original Double-Flow were the most efficient of that period. Herringbone eliminators in Class 500 Double-Flows remove more entrained moisture and reduce the static pressure drop.

In 1938, The Marley Company introduced a new cooling tower that was to prove to be the most important single advancement in the entire history of industrial water cooling — the Marley Double-Flow. Far from being just an improvement or refinement of existing cooling towers, the Double-Flow was an entirely new concept of water cooling based on the revolutionary cross-flow principle of a single fan serving two cooling cells by drawing air *horizontally* across both cells.

Since that time, more than 2000 Double-Flows, involving more than 6000 fan cells, have been put into industrial service, and the billions of gallons cooled daily by Double-Flows exceed installed capacity of any other type of tower. The Double-Flow has become, by any standard of measurement, the Number One Industrial Cooling Tower, both at home and abroad.

Performance has keyed Double-Flow's popularity over the past two decades: **performance** that is a matter of record, based on valid and published tests. **Dependable performance**—earliest Double-Flows are still in daily service. **Continually-upgraded performance**—Marley has constantly improved fans, fan cylinders, drift eliminators, fill, mechanical equipment . . . every functional and structural element . . . all to further its goal of "moving more air to cool more water more efficiently".

The Marley Company believes that the ultimate in cooling towers is "always building, never built . . . " and is proud to present the new Class 600 Double-Flow that embodies many new and important advancements in water cooling practice and achievement.

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and 2000 Double-Flows later

Marley Class 600 Double-Flows

again revolutionize water cooling!

The Class 600 Double-Flow is unusual in profile, unprecedented in performance—and here are the highlights: Angular sidewall construction and fill of uniform width at all elevations permits increased cooling capacity in every frame size with greater power economy and conservative basin cost . . . from the new wide angle louvers to the fan, air flow is cleared of obstructing elements, resulting in lower draft loss, more efficient air movement . . . angled louvered walls prevent splash-out, prevent winter icing . . . new inert materials throughout tower extend service life. Get complete information on these modern cooling towers from the Marley engineer in your city or write The Marley Company.

The Marley Company

Kansas City, Missouri

MARLEY

LIME

SILICATE PIGMENT

SODIUM CHROMATE

POLYVINYL CHLORIDE

SODIUM BICARBONATE

DICALCIUM PHOSPHATE

CITRIC ACID

POTASSIUM CARBONATE

BARIUM OXIDE

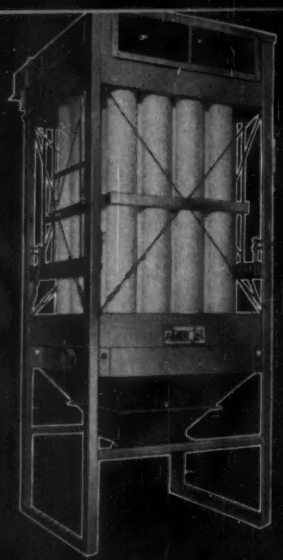
SODIUM FORMATE

BORIC POWDER

AMMONIUM NITRATE

ALUMINA HYDRATE

CARBON DUST



AMERjet—for collection of the very finest particles and particles that must be recovered dry.

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LEAD OXIDE

STARCH DUST

TITANIUM DIOXIDE

ALUMINUM OXIDE

PIGMENTS

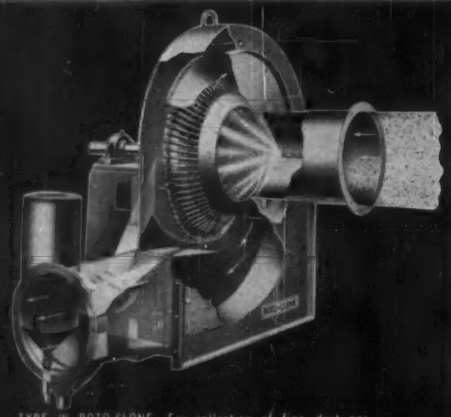
CAUSTIC VAPORS

CARBON DUST

LEAD STEARATE

CLAY

BARIUM SULFIDE



TYPE W ROTO-CLONE—For collection of fine dust particles in moderate concentrations.

TRIPLE TROUBLE

CUPRIC OXIDE

CALCIUM SULFATE

ALUMINA

CARBON BLACK

INSECTICIDES

AZO DYE

VOLCANIC ASH

FUNGICIDE POWDER

FERTILIZER DUST

GLYCERIN VAPOR

PLASTICS

HERMICULITE DUST

LIME

ALUMINUM POWDER

PHOSPHATES

BARIUM CARBONATE

TYPE N ROTO-CLONE—For collection of heavy dust loadings of all particle sizes.

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ZINC STEARATE

SODIUM CITRATE

BARIUM SULFATE

ALUMINUM SILICATE

T.N.T.

SODIUM SILICATE

AMMONIUM SULFATE

METALLIC OXIDES

BAUXITE

PIGMENTS

PHENOLIC RESINS

FOR DUST!

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Illinois Heating Specialties

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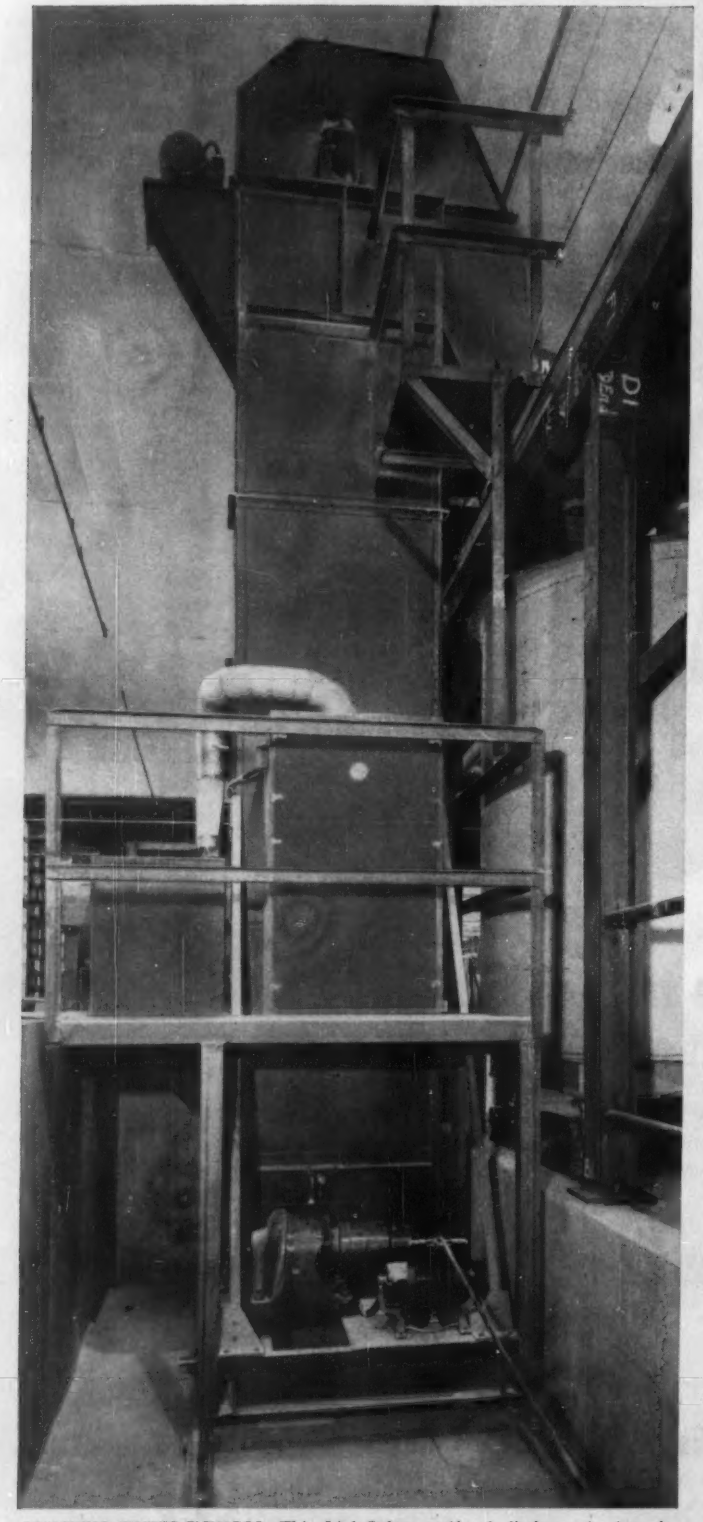

TRAVELING BUCKET ELEVATOR. This Link-Belt centrifugal discharge bucket elevator, mounted on a steel, self-propelled carriage, travels along rails and serves a line of processing tanks.

LINK-BELT makes all elements for bucket elevators

RESULT:
easier installation
smoother performance

If bucket elevator components don't match perfectly, time and effort needed for assembly can send installation costs skyrocketing. And if misalignment isn't corrected, it soon shows up in bucket and casing wear, undue drag and friction, excessive maintenance and downtime.

Integrated Components

Link-Belt prevents these costly installation and operational headaches . . . eliminates them in the *factory*, not in the field. Making *everything that goes into a bucket elevator*, Link-Belt carefully designs, manufactures and integrates all components for perfect, ready alignment. As a result, unnecessary erection costs and difficulties are avoided . . . efficient, long-lasting elevator performance is assured.

One-Source Service

Equally important, the completeness of Link-Belt's line makes it easy to select the proper type bucket elevator and components best suited to your material and capacity requirements. Link-Belt will erect your elevator and accept full installation responsibility. For complete details, contact your nearest Link-Belt office.

LINK-BELT

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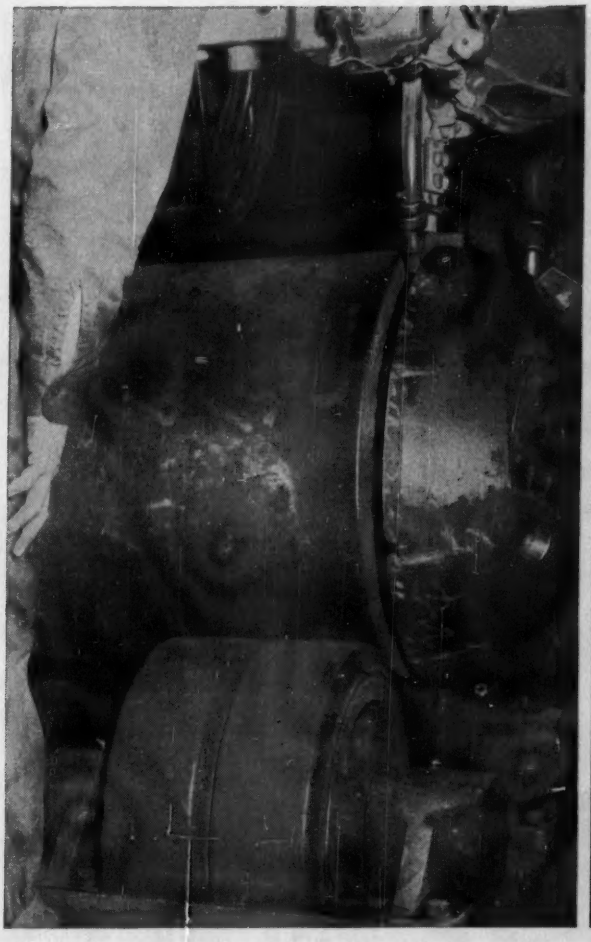

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2-inch-thick seam at Downingtown

Item: Air Dryer Cylinder
Material: Carbon Steel
Thickness: Head, 2"—Shell, 2-5/16"
Design Pressure: 3200 psi
Hydrostatic Test Pressure: 5400 psi
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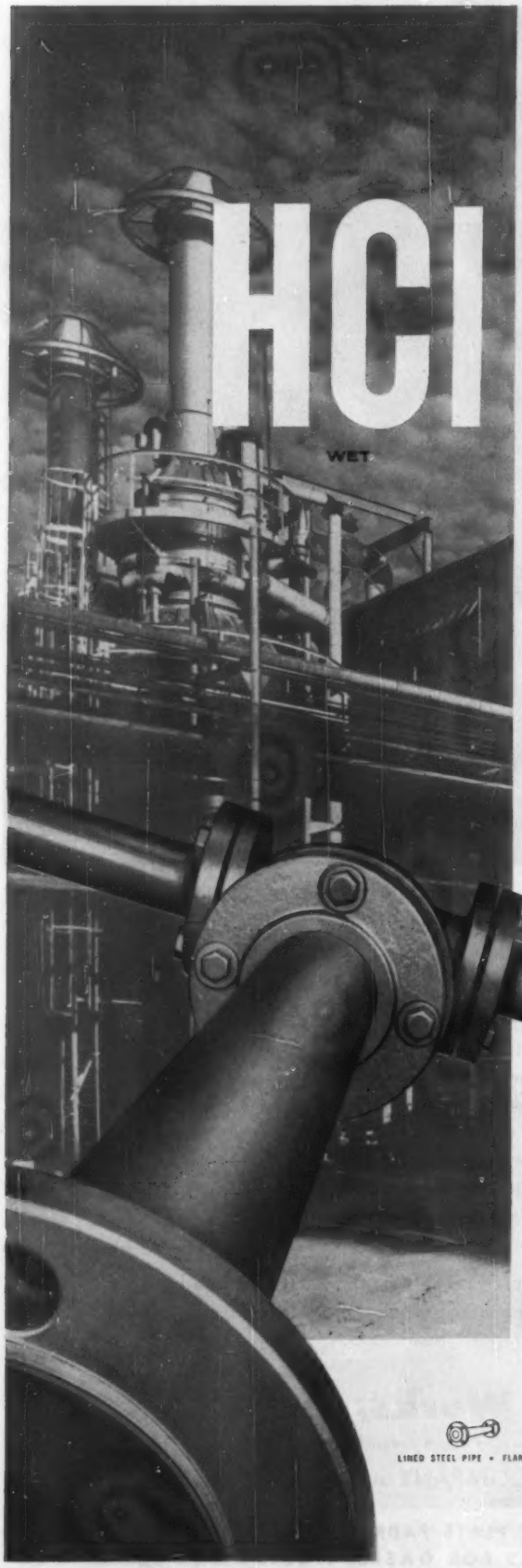

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CAN'T CORRODE FLUOROFLEX®-T PIPE

Lining is completely inert to all corrosives. It's made of Fluoroflex-T, a high density, non-porous compound* of virgin Teflon.

Liner and housing are in thermal equilibrium through an exclusive process developed by Resistoflex. It compensates for thermal expansion differential between the Teflon and the pipe housing, eliminating fatigue collapse, and cracking at the flange.

Saves $60,000 monthly at one chemical processing plant. Frequent piping failures cost that much in excessive maintenance and product loss. An exhaustive search among all types of piping uncovered only one system that could handle the mixture of 25% hydrochloric acid and organic solvents at 300°F and 100 psi without difficulty – Fluoroflex-T Type S piping. With over 1500 feet and 400 fittings now in service–some for more than 18 months–there have been *no failures.*

Fluoroflex-T Type S piping systems can handle the toughest problems of corrosion, erosion and contamination for you, too, with complete safety. Send for Bulletin TS-1A. Dept. 148, RESISTOFLEX CORPORATION, Roseland, N. J. Other Plants: Burbank, Cal., Dallas, Tex.

® Fluoroflex is a Resistoflex trademark, reg., U. S. pat. off.
® Teflon is DuPont's trademark for TFE fluorocarbon resins

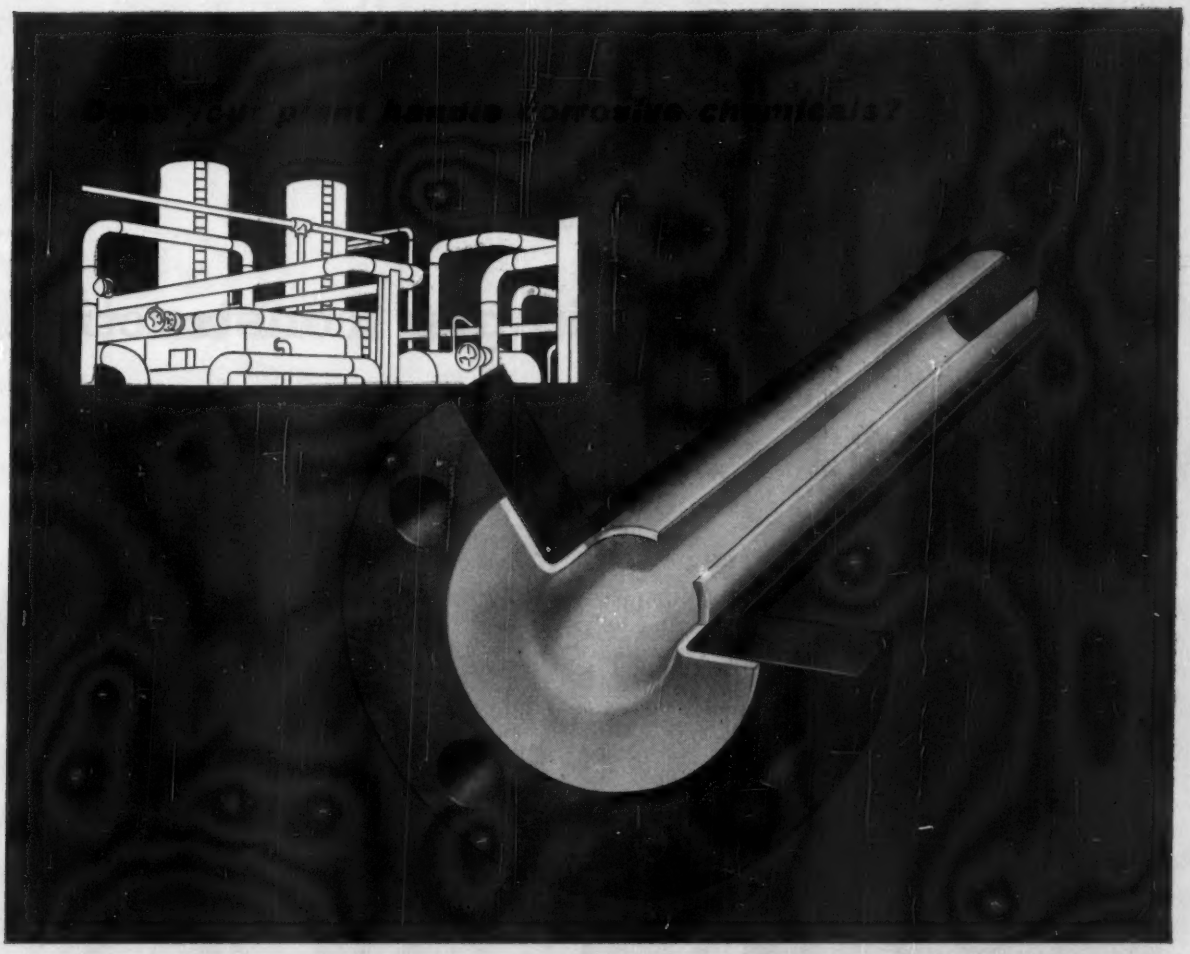
** Pat. No. 2,752,637*

liner of TEFLON®
in thermal equilibrium with housing

RESISTOFLEX

Complete systems for corrosive service

LINED STEEL PIPE • FLANGED FLEXIBLE HOSE • BELLOWS • ELBOWS • TEES • REDUCERS • DIP PIPES & SPARGERS • LAMINATED PIPE



Pipe lined with a TFE-fluorocarbon resin eliminates costly replacements and maintenance

Pipe lined with a TEFLON TFE-fluorocarbon resin can save you money by substantially reducing process shutdown, pipe replacement and system maintenance. It will increase plant safety by eliminating the hazard of corrosion-caused leaks and disassembly of chemical lines.

TFE-fluorocarbon resins withstand the most corrosive chemicals used in the industry. For example, sections of this lined pipe were installed in an aqueous process stream carrying HCl liquid and vapor, plus organic solvents and reagents at temperatures above 220°F! After more than two years, inspection showed their condition to be so good that they were reinstalled under even more severe conditions. Because of this outstanding performance, the plant has greatly extended the use of TFE-lined pipe.

TFE-fluorocarbon pipe liner has many other advantages. It is rated for use up to 500°F. It won't shatter under vibration or physical or thermal shock, like brittle lining. The non-adhesive properties of TFE resins make them ideal for handling sticky or viscous substances. The liner flared over the flanges provides complete protection for the metal from the process fluids and eliminates the need for additional gasketing. And now you can get a complete assortment of standard sizes, flanged pipe, tees, elbows and reducers, all lined with TEFLON TFE resins.

For long service life, greatly reduced maintenance and downtime, and greatly increased plant safety, install pipe lined with TEFLON. Call your local pipe supplier for the details. Or, for more information, write to: **E. I. du Pont de Nemours & Co. (Inc.), Polychemicals Department, Room 711, Du Pont Building, Wilmington 98, Delaware.**

IN CANADA: Du Pont Company of Canada (1956) Limited, P. O. Box 660, Montreal, Quebec.

DU PONT TEFLON®

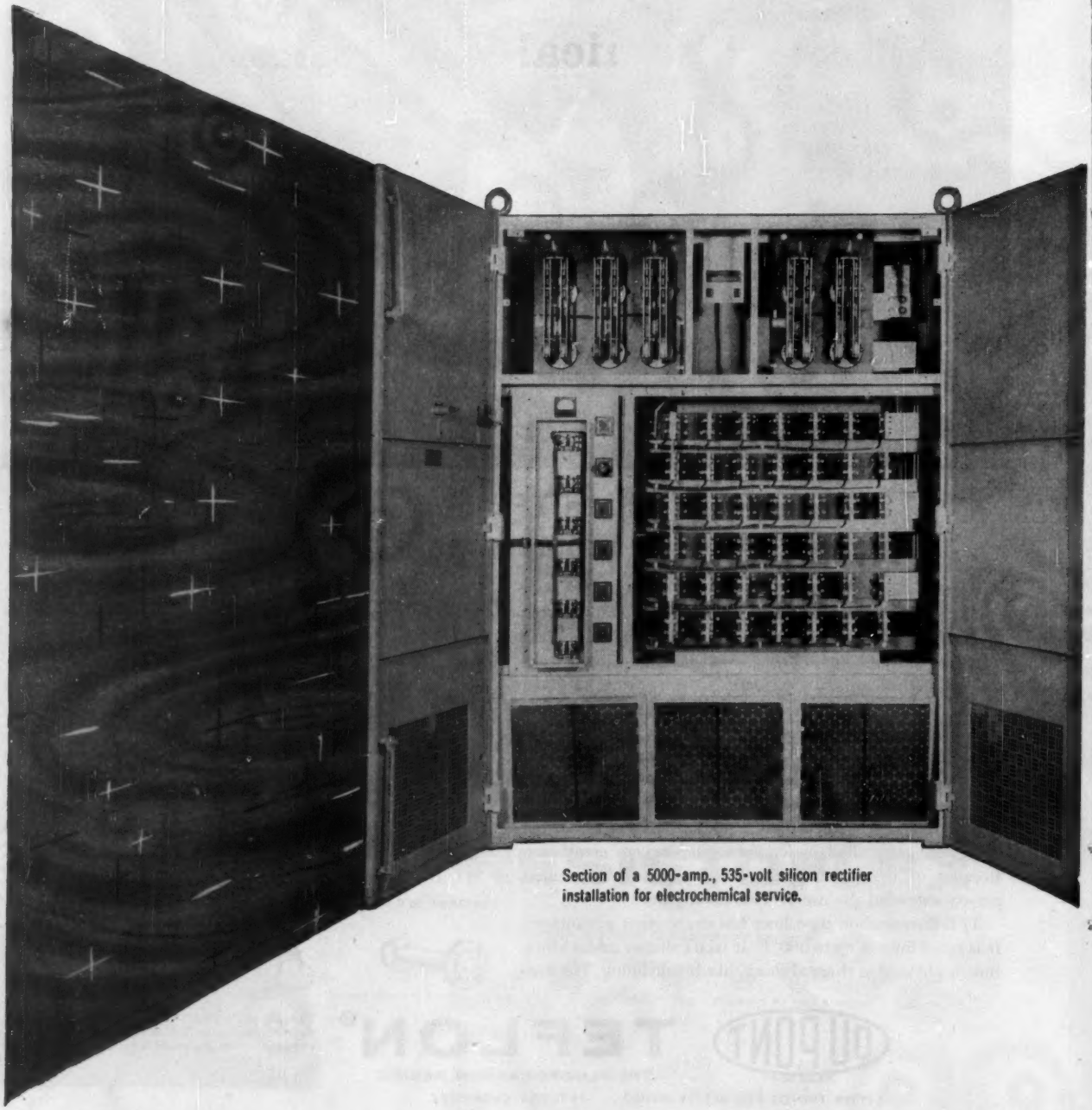
TFE-FLUOROCARBON RESINS

BETTER THINGS FOR BETTER LIVING . . . THROUGH CHEMISTRY

TEFLON is Du Pont's registered trademark for its fluorocarbon resins, including the TFE (tetrafluoroethylene) resins discussed herein.

Westinghouse Silicon Rectifiers...

higher efficiency, simpler construction



Section of a 5000-amp., 535-volt silicon rectifier installation for electrochemical service.

for medium and low voltage

electrochemical processing economy

Helping you curb the high cost of processing is the job of these new air-cooled, high-efficiency Westinghouse silicon rectifiers. Cost of power — as reflected in final product costs — is now made lower than ever before.

Low cost . . . advanced circuitry eliminates complicated excitation equipment and simplifies construction.

High efficiency . . . approximately 95% overall, for low and medium voltage applications.

Long life . . . no detectable aging of silicon cells has occurred even after many years of use.

Ease of installation . . . units are completely factory-assembled. You need only make a-c and d-c connections.

No costly outages . . . indicating equipment will detect cell failure. Drawout construction makes replacement quick and easy without dropping load.

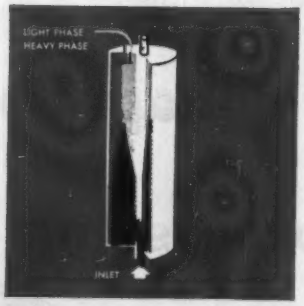
For full information on Westinghouse silicon rectifiers for electrochemical applications, call your Westinghouse representative or write Westinghouse Electric Corporation, P.O. Box 868, Pittsburgh 30, Pennsylvania. J-15008

YOU CAN BE SURE...IF IT'S Westinghouse

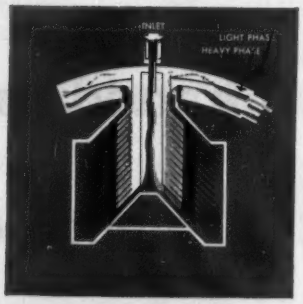
SHARPLES...

... for SEPARATION of IMMISCIBLE

SUPER-CENTRIFUGE

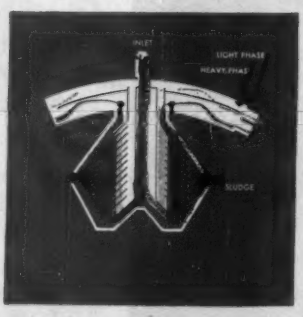


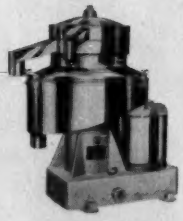
SOLID BOWL CENTRIFUGE



... for CONTINUOUS CONCENTRATION and

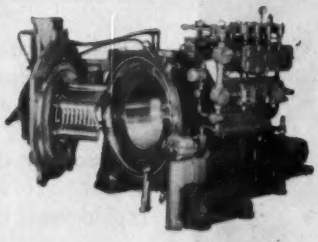
DH-6 HIGH CAPACITY NOZLJECTOR

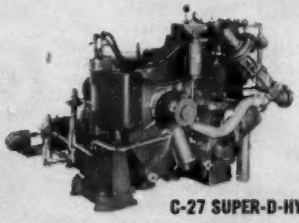




DH-3 NOZLJECTOR

... for RECOVERY, WASHING, and DEHYDRATION of CRYSTALS





C-27 SUPER-D-HYDRATOR

With the addition of the C-41, the three sizes of Sharples SUPER-D-HYDRATOR cover the broadest range of capacity—These are completely automatic, horizontal perforate basket centrifuges which operate continuously at full speed for the recovery, washing, and dehydration crystals. Special designs available for pressure operation.

SHARPLES PROCESSES and PROCESS ENGINEERING

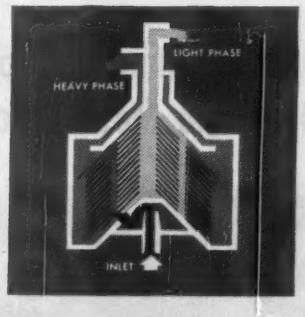
range from complete plants such as complete soap plants, vegetable oil processing plants, tall oil recovery plants, animal fat rendering, treatment of residual oil,to unit operations such as dehydration of numerous types of crystals, desludging, etc. Your problems will be analyzed by experienced process engineers.

THE COMPLETELY INTEGRATED LINE OF CONTINUOUS CENTRIFUGES

High Capacity • High Pressure • Peak Performance

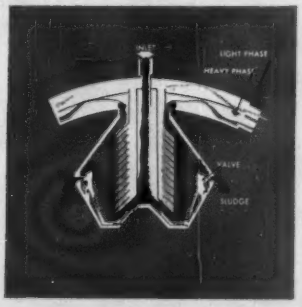
LIQUIDS and for CLARIFICATIONS

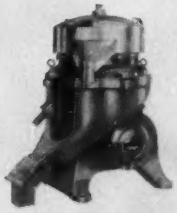
PRESUR-SEALD CENTRIFUGE



A wide choice of centrifuge types, including the Sharples SUPER-CENTRIFUGE, which develops the highest centrifugal force commercially available, 13,200 X G, as well as disc bowl centrifuges, and the Sharples PRESUR-SEALD centrifuge for operation under positive pressure.

REMOVAL of SOLIDS from LIQUIDS

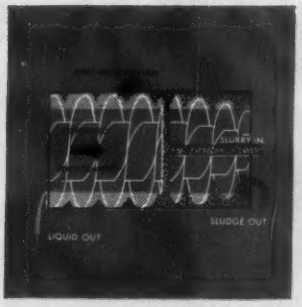




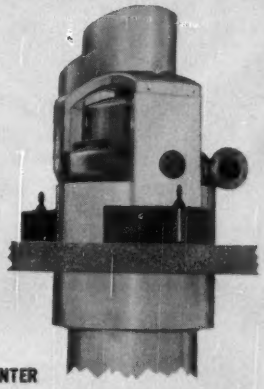
AUTOJECTOR

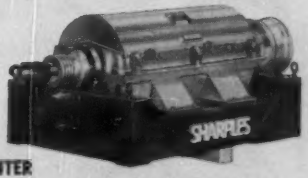
Sharples offers the widest range of NOZL-JECTOR and other nozzle type centrifuges available to effect separations, clarifications and solids concentrations of varying complexity. Internal or external control of valves provides intermittent or continuous discharge of concentrated solids; highest capacities with peak performance; pressures to 150 psi.

. . . for CONTINUOUS DEWATERING of SLUDGES and SLURRIES



P-7000 SUPER-D-CANTER





P-3000 SUPER-D-CANTER

Six sizes of Sharples Super-D-Canters for continuous removal of solids from slurries and suspensions; recovery, dewatering, and washing fine crystals and other solids, and wet classification of solids. Complete range of capacities; pressure operation to 150 psi.

SHARPLES THE SHARPLES CORPORATION

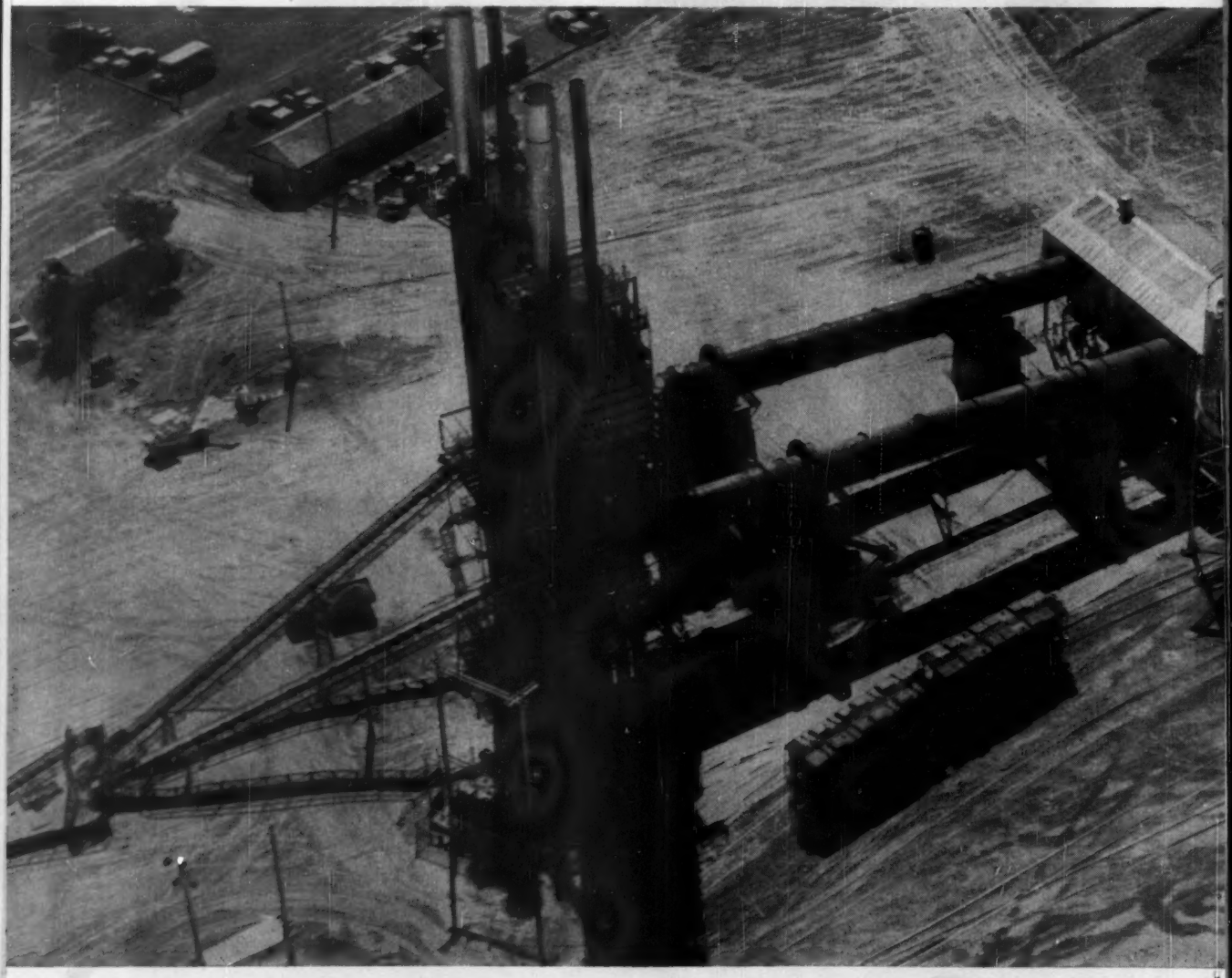
2300 WESTMORELAND STREET • PHILADELPHIA 40, PENNSYLVANIA

NEW YORK•PITTSBURGH•CLEVELAND•DETROIT•CHICAGO•NEW ORLEANS•SEATTLE•LOS ANGELES•SAN FRANCISCO•HOUSTON•ST. LOUIS•ATLANTA

Associated Companies and Representatives Throughout the World

Another Complete KENNEDY

Apex, Nevada, Plant of the United States Lime Division of the Flintkote Company is the Largest, Most Modern and Most Efficient in the West.



KENNEDY VAN SAUN

MANUFACTURING & ENGINEERING CORPORATION

405 PARK AVENUE, NEW YORK 22, N.Y. • FACTORY: DANVILLE, PA.

CRUSHERS • PULVERIZERS • KILNS • PREHEATERS • DEHEATERS • SCREENS • CONVEYORS

Lime Plant

FLINTKOTE *Manufacturer of the broadest line of Building Products in America*

Two 10'x 150' KENNEDY Rotary Kilns, with their KENNEDY Preheaters and Contact Coolers, are the principal components of this modern, efficient lime plant — designed by KENNEDY.

PULVERIZED COAL FIRING SYSTEMS • HYDRATORS

✓Check these KENNEDY features for

High Output

High Quality

Low Fuel Consumption

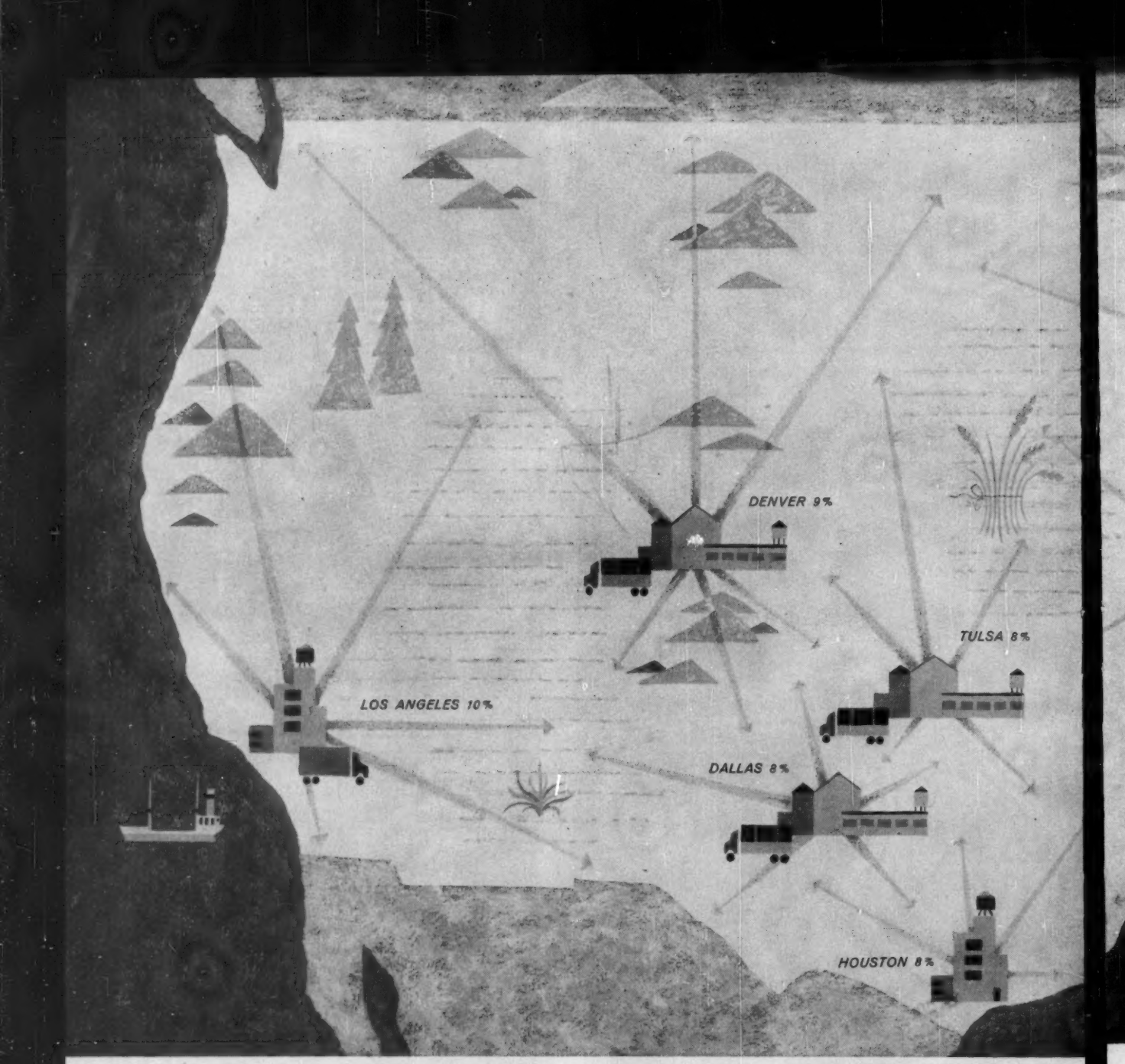
Low Maintenance

Minimum Labor Requirements.

- **KENNEDY** Stone Preheater
- **KENNEDY** Short-2 tire Rotary Kiln
- **KENNEDY** Contact Cooler
- **KENNEDY** Natural Gas Burner— specially designed for Rotary Kilns
- **KENNEDY** Centralized Kiln Control Cubicle

KENNEDY Lime Plants—throughout the world—are noteworthy for their DEPENDABILITY and PROFITABLE OPERATION

Consult us for your lime processing needs— Equipment—Design—Complete Lime Plants.



NEW SAVINGS ON

Look at the map to see how much *less* you pay!

Refer to Chemical Engineering Catalog for Detailed Description of Worthington Standard Pumps

Worthington has reduced the cost of SESC pumps by spanning the nation with *new regional assembly depots.* In addition to the primary depot in East Orange, (N.J.), others have been established in Cleveland, Atlanta, St. Louis, Houston and Los Angeles. Worthington can now pass along savings to you in three ways. One, on the price: as much as 10% depending upon your location. Two, on time—because your order can be processed and shipped in a matter of hours. Three, on parts service—because each of the assembly depots maintains a stock of spare parts.

In addition to assembly points, Worthington also maintains stocks of completely built pumps in Buffalo, Chicago, Denver, New Orleans, Dallas and Tulsa.

But there are other reasons why SESC (standard end

BUFFALO
CHICAGO 6%
CLEVELAND 5%
EAST ORANGE
ST. LOUIS 7%
ATLANTA 8%
NEW ORLEANS 7%
KEY
REGIONAL ASSEMBLY DEPOTS
REGIONAL STOCKING WAREHOUSES
Because you pay only freight charges from the *nearest* assembly depot, Worthington pumps now cost you up to 10% less. Map shows how much you save on the total cost of a pump at each assembly depot or warehouse.

WORTHINGTON PUMPS

suction centrifugal) is far and away your best pump buy. Standardization gives you a high degree of interchangeability. Pumps may be all iron, all bronze, standard fitted, or Worthite*. 120 different sizes, with open or closed impellers are available with capacities up to 2700 GPM and heads to 550 Ft. Conventionally packed boxes or mechanical seals are optional in all pumps, and conversions from packed boxes to seals may be made on units in the field. All in all there are 70,480 modifications of the SESC pump to choose from—the broadest combination the pump industry has to offer.

SESC pumps also give you these benefits of standardization. You can cut your spare parts inventory by 50% because only four bearing frame sizes are used for the entire 120-pump line, and all pump parts are interchangeable. This means reduced downtime if repair or conversion is made. Finally, one basic design for the complete line simplifies maintenance and lowers overall operating costs.

Take advantage of the new low costs—the speeded delivery—the many outstanding features of the Worthington SESC line now. For detailed information, write for Bulletin W-300-B-4-B. Worthington Corporation, Section 20-3, Harrison, New Jersey. In Canada: Worthington, Ltd., Brantford, Ontario.

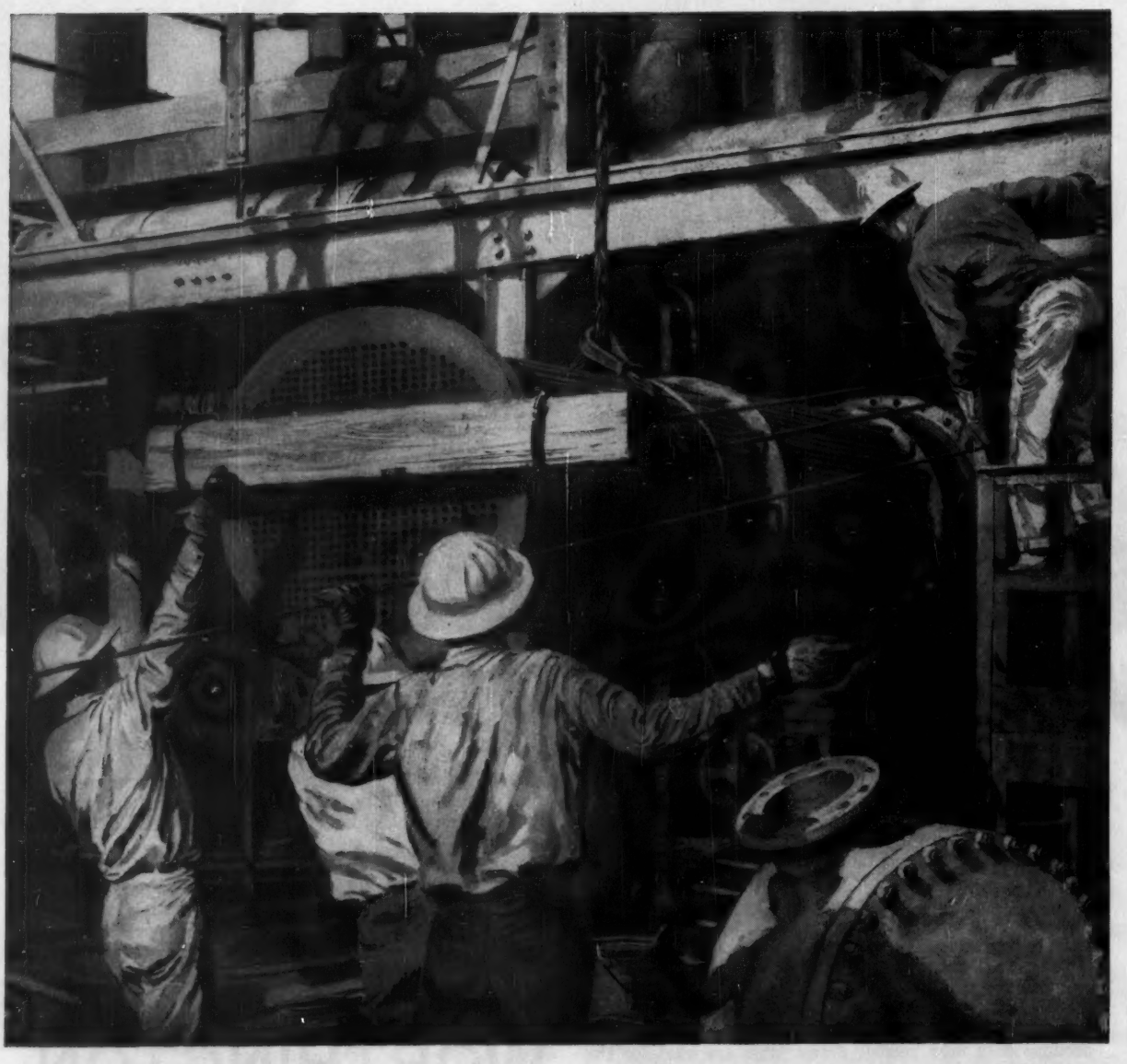
*Worthite is a high nickel, high-chromium, low-carbon alloy steel. Trademark Reg. U. S. Pat. Off.

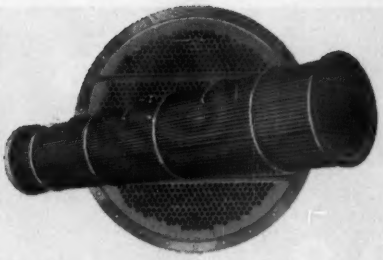
WORTHINGTON

RETUBE YOUR BUNDLES WITH | PHELPS DODGE

HEAT EXCHANGER AND CONDENSER TUBES

FOR LONG-RUN RELIABILITY!





- Wide range of finest quality copper-base alloys—bi-metal combinations—to fit your application needs.
- Well-stocked, nation-wide warehouses at Houston, Tulsa, Los Angeles and Bayway, N. J.
- Experienced engineering staff at your service to help solve tube corrosion problems.

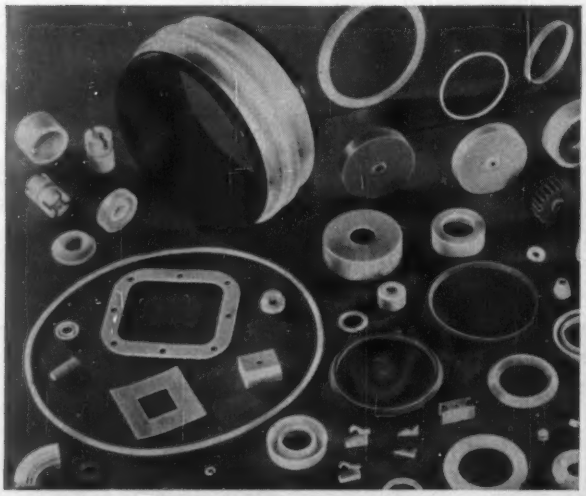
Specify Phelps Dodge . . . a leading manufacturer of tubes for the fabricators of heat exchangers and condensers!

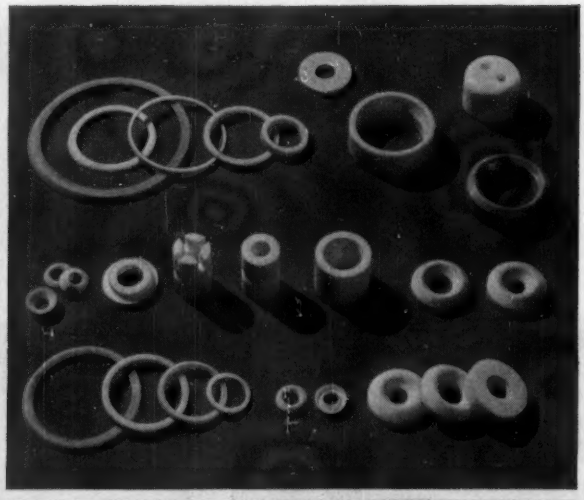
PHELPS DODGE COPPER PRODUCTS CORPORATION

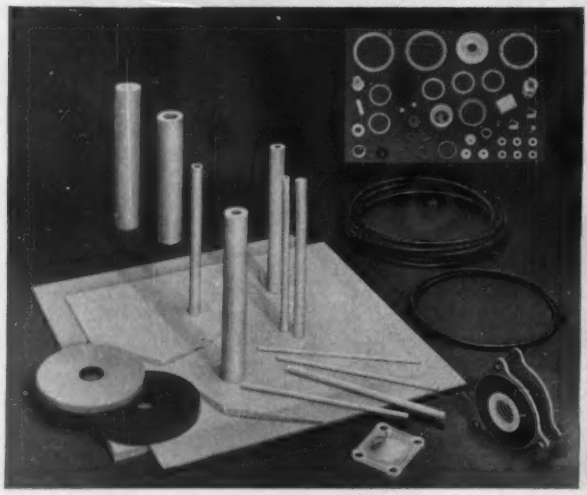
SALES OFFICES: Atlanta, Birmingham, Ala., Cambridge, Mass., Charlotte, Chicago, Cincinnati, Cleveland, Dallas, Dayton, Detroit, Fort Wayne, Greensboro, N. C., Houston, Indianapolis, Jacksonville, Kansas City, Mo., Los Angeles, Memphis, Milwaukee, Minneapolis, New Orleans, New York, Philadelphia, Pittsburgh, Portland, Ore., Richmond, Rochester, N. Y., San Francisco, St. Louis, Seattle, Washington, D. C.

FIRST FOR LASTING QUALITY—FROM MINE TO MARKET!

R/M is your best single source for TEFLON* in any form







Pioneering in the fabrication of "Teflon," R/M has built a solid record of achievement in utilizing the unique properties of this material. Our engineers have done many things previously considered impossible, such as molding very complex valve diaphragms.

In addition to the knowledge and skill of its personnel, R/M has the production facilities to produce "Teflon" in *any* form and quantity you require. Make us your prime source for every "Teflon" product, from sheets, rods, tubes, tape and flexible wire braid covered hose to the most intricate molded and machined components.

No matter how exacting your specifications, depend on R/M to meet them with complete satisfaction. Your nearby R/M district office will be glad to give you the cooperation you need when your project is in the design stage. Or write for free literature and detailed information.

*A Du Pont trademark

R/M

RAYBESTOS-MANHATTAN, INC.

PLASTIC PRODUCTS DIVISION FACTORIES: MANHEIM, PA.; PARAMOUNT, CALIF.

Contact your nearest R/M district office listed below for more information or write to Plastic Products Division, Raybestos-Manhattan, Inc., Manheim, Pa.

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NEW ORLEANS 17 • PASSAIC • PHILADELPHIA 3 • PITTSBURGH 22 • SAN FRANCISCO 5 • SEATTLE 4 • PETERBOROUGH, ONTARIO, CANADA

RAYBESTOS-MANHATTAN, INC., Engineered Plastics • Asbestos Textiles • Mechanical Packings • Industrial Rubber • Sintered Metal Products • Rubber Covered Equipment
Abrasive and Diamond Wheels • Brake Linings • Brake Blocks • Clutch Facings • Laundry Pads and Covers • Industrial Adhesives • Bowling Balls

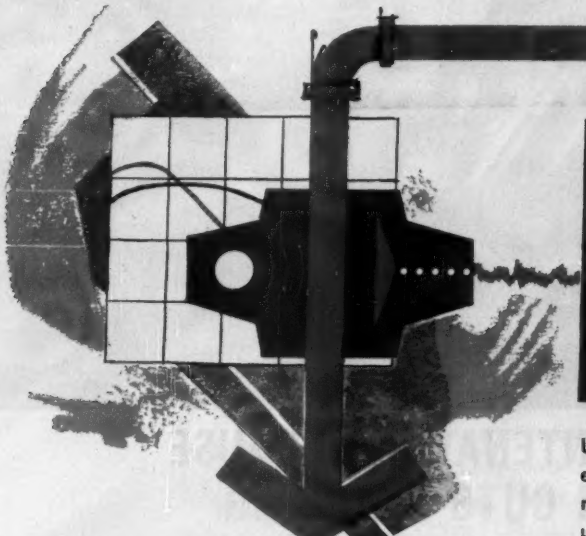
modernization means reduced costs...increased efficiency

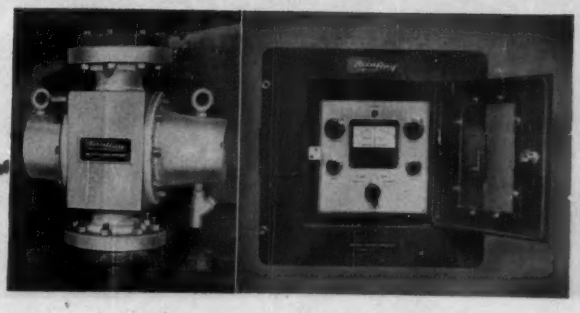
MODERNIZATION ALSO MEANS

AccuRay®

DENSITY MEASURING SYSTEMS

AccuRay now offers the process industries unlimited opportunities for greater profits through increased production and improved quality control. AccuRay's density measuring system gives management greater control over production processes without time-consuming delays for sampling and adjusting the process. Continuous, accurate measurement of density, specific gravity, concentration, or percent solids is essential in determining where economies can be effected. AccuRay's density system provides this information continuously and accurately from the exterior of the pipe, without contacting the process material. The AccuRay Density Measuring System has been designed to meet the rigorous requirements of the process industries. An AccuRay System can play an important part in your modernization plans.





Use AccuRay to increase profits through the close control of evaporator feed and effluent; extraction solvent-feed ratios; reactor catalyst-feed ratios; distillation unit feed and product qualities; proportioning of reactants and products; and feed and product quality measurements in the many separation processes of filtration, centrifuging, cycloning, flotation, and clarification.

Industrial Nucleonics
CORPORATION
1149 CHESAPEAKE AVE. • COLUMBUS 12, OHIO

Please send Bulletin NI-158 for complete details on AccuRay Continuous Flow Density Systems

Name ..... Title .....
Company .....
Street .....
City ..... Zone ..... State .....
Application .....

SEE THE **INDUSTRIAL NUCLEONICS'** EXHIBIT—BOOTHS 576-671—NATIONAL PLASTICS EXPOSITION—CHICAGO, NOVEMBER 17-21

LESS BOILER MAINTENANCE BECAUSE A LJUNGSTROM CUTS SLAGGING

A Ljungstrom air preheater reduces slagging and cuts boiler downtime by boosting combustion air temperature, in some cases by as much as 1000°F. Whatever fuel you use, hotter combustion air makes it burn more cleanly and completely, with less slag and deposits.

More complete combustion also makes standard equipment work at top efficiency, producing more heat from less fuel. One east coast refinery saves $129,000 a year on their fuel bill through increased furnace efficiency. This increased efficiency contributes to an upgrading of the product by 1½ octane numbers, providing an additional annual profit of $58,000.

How fast is "WRITE-OFF"?

Savings like these — where equipment makes a better product . . . lasts longer . . . and costs less to maintain — can pay for a Ljungstrom air preheater *in as little as two years.* Or, if you use the higher combustion efficiency of a Ljungstrom-equipped furnace to increase throughput, write-off time can be cut to nine months!

For further information on potential fuel economy, write today for your copy of a factual article by O. F. Campbell describing one company's fuel savings with a Ljungstrom air preheater. Call or write The Air Preheater Corporation.

THE AIR PREHEATER CORPORATION

60 East 42nd Street, New York 17, N. Y.

A TWO-MINUTE STORY THAT CAN SAVE YOUR COMPANY THOUSANDS OF DOLLARS

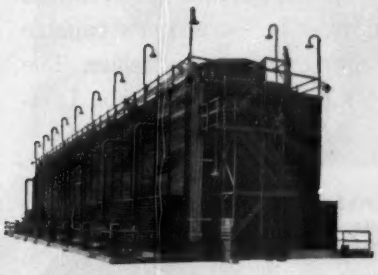
What the old timer said to the young engineer about buying cooling towers

"Buy 'em big, young man. That's the only way you can be sure the tower will handle your job."

"Isn't that expensive?" asked the young engineer. "Why can't we specify the exact capacity we need and get bids on the proper size tower? Seems like we would save money."

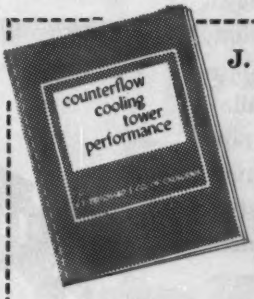
"Not enough known about tower performance, so play it safe and buy it big."

The Old Timer has a point. And, until now, he was forced to abide by it – forced to buy in the dark and pay the penalty of over-buying to protect his company. But there's been an important change. Now, for the first time, all of the information needed to determine counterflow cooling tower performance is available in one easy-to-use handbook.



Ask Pritchard to bid on the next cooling tower you need – then check our figures using the Performance Handbook. You'll see in black and white how a Pritchard Cooling Tower gives you more value for your money.

This handbook, entitled "Counterflow Cooling Tower Performance" also can be used to check tower selections before you buy. It contains technical data and charts prepared by leading authorities in cooling tower design. It's available from Pritchard for $3.00. Mail coupon below and check or money order for your copy.



J. F. PRITCHARD & CO. OF CALIFORNIA
Dept. 110, 4625 Roanoke Parkway, Kansas City 12, Mo.

☐ Enclosed is $3.00. Please send copy of "Counterflow Cooling Tower Performance"
☐ Please send free copy of new Counterflow Cooling Tower Bulletin 4.9.080A
☐ Please have your representative call on me

Name_____ Title_____
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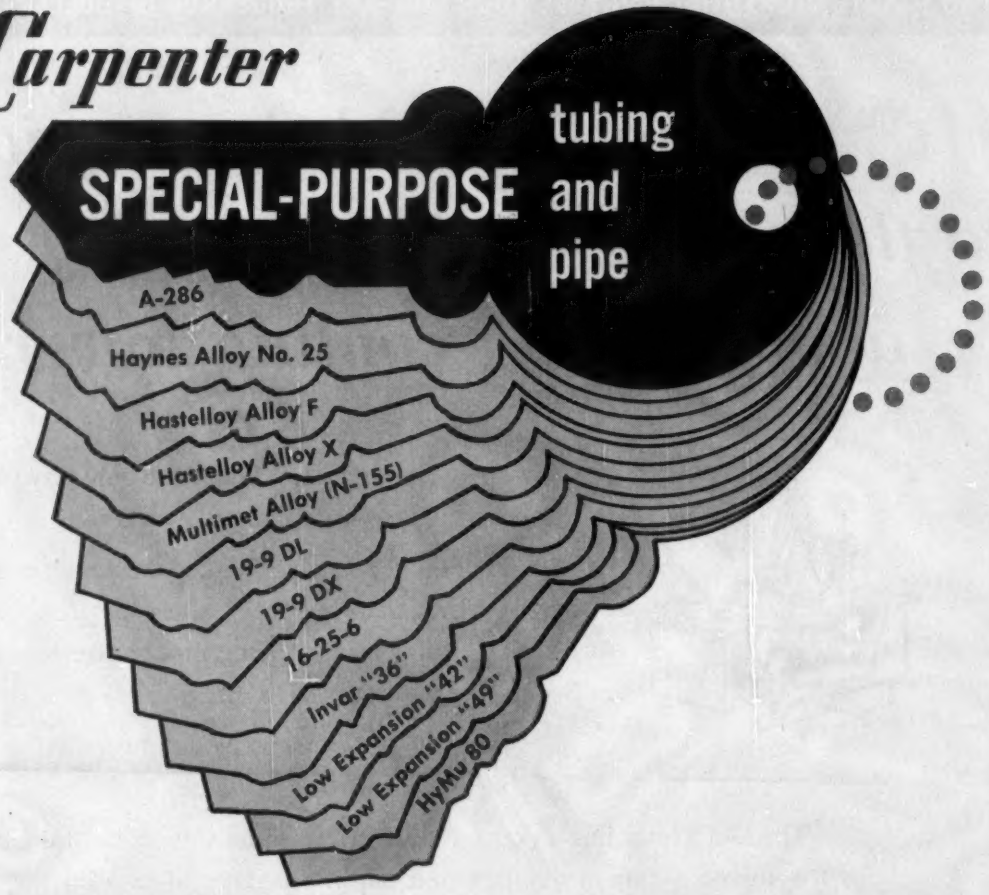
City_____ Zone____ State_____

Carpenter



12 master keys to many NEW needs

• As fast as new developments in products and equipment create new needs in tubing and pipe for corrosion and heat control, Carpenter is ready with the answers. Whatever it takes, Carpenter makes . . . to meet the challenge of technological progress.

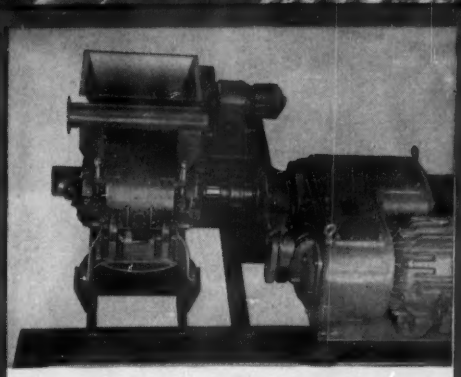
Listed above are 12 Special-Purpose types of Carpenter tubing and pipe that answer today's needs for high-temperature, low-expansion, high-permeability and corrosion-resistant applications. These super-stainless and high alloy grades meet a broad range of tubing and pipe requirements for vital parts of jet aircraft, missiles, rockets, nuclear energy equipment, instruments, electronic devices, process equipment and other advanced developments. Their properties, recommended uses and other technical data are contained in a new bulletin—T.D. 125.

Write for a copy on your company letterhead. Put your special-purpose requirements for tubing and pipe in Carpenter's capable hands by contacting our nearest office. The Carpenter Steel Company, Alloy Tube Division, Union, N. J.

your master key to cost-savings

special-purpose tubing and pipe

Powdered to power the rockets.....



Stainless steel MIKRO-PULVERIZER complete with variable drives and remote controls.

MIKRO-PULVERIZERS are helping to improve and increase the output of rocket fuel materials ground to rigid "space age" specifications . . . easily and safely handling hygroscopic and highly explosive materials such as ammonium and potassium perchlorate. As a result, a uniform finished product can be produced.

A MIKRO-PULVERIZER, operating in a controlled atmosphere, can be incorporated in a completely closed and contamination-free system, with 99.9% *plus* product recovery in a MIKRO-PULSAIRE Collector.

Regardless of what your grinding problem is, we can help you "get it off the ground". The MIKRO-D laboratory will gladly test the material you grind or collect and submit recommendations without obligation. Send today for confidential data sheets. *And ask for Bulletin 51A.*

Mikro-D

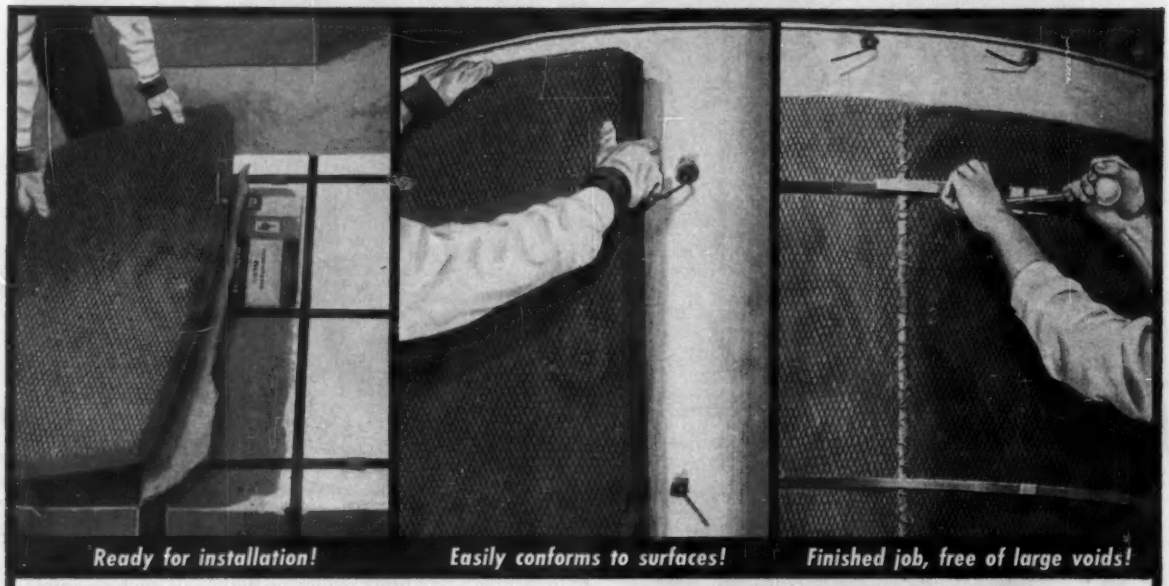
PULVERIZING MACHINERY DIVISION
METALS DISINTEGRATING COMPANY, INC.
55 Chatham Rd., Summit, New Jersey

GENUINE MIKRO-D REPLACEMENT PARTS AVAILABLE FROM LARGE STOCK WITHIN 48 HOURS

MANUFACTURERS OF PULVERIZING, AIR CONVEYING AND DUST COLLECTION EQUIPMENT

FACTORY FABRICATED TO RIGID SPECIFICATIONS!

EAGLE-PICHER BLANKET INSULATION



Ready for installation! *Easily conforms to surfaces!* *Finished job, free of large voids!*

- Copper bearing steel laths, bound by uniformly spaced soft-drawn galvanized tie wires, keep blankets firm but flexible.
- Eagle-Picher mineral wool evenly dispersed over entire insulating area of each blanket.
- Completely free of large voids usually found in field-made blankets where insulation is simply packed in place.
- Smooth edges butted tightly together eliminate cracks and loose joints.
- Quickly applied to flat or slightly curved surfaces of any large equipment—or cut to fit irregular areas.
- Maximum thermal efficiency at temperatures as high as 1200 F.

Eagle-Picher produces a complete line of industrial insulations for all temperatures from below Zero to over 2000 F.

FREE SAMPLE!

Write today!

Eagle-Picher Blanket Insulation conforms to Commercial Standard CS-117-49.

Since 1843

EAGLE PICHER

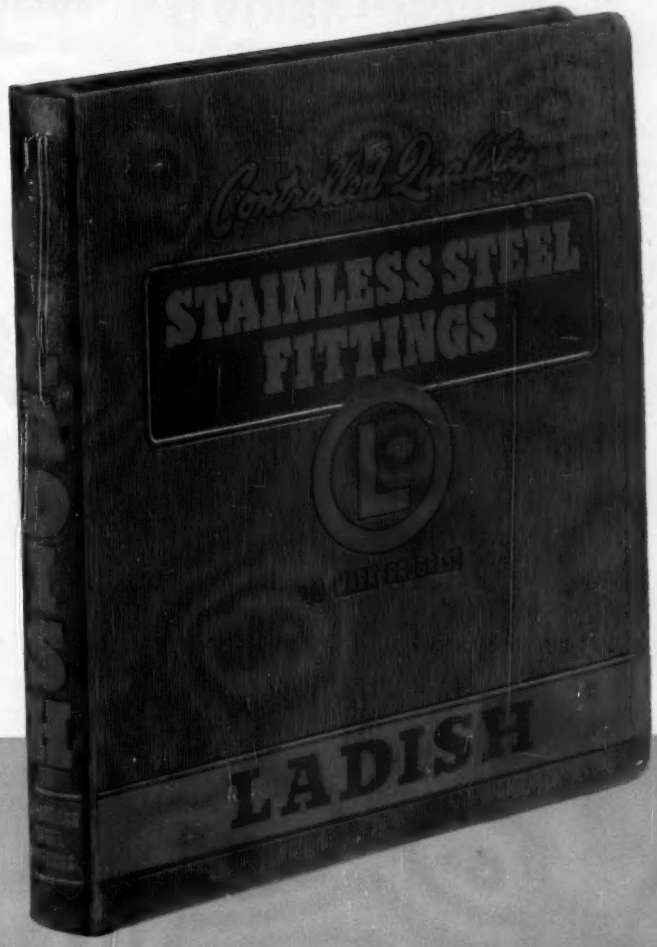
EAGLE-PICHER

The Eagle-Picher Company • General Offices: Cincinnati 1, Ohio

(Member of Industrial Mineral Fiber Institute)

NEW LADISH CATALOG

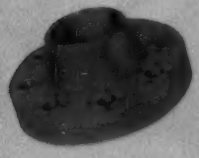
GIVES DETAILED SPECIFICATIONS, DIMENSIONS AND ORDERING INFORMATION ... PLUS USEFUL TECHNICAL DATA ON COMPLETE LINE OF STAINLESS STEEL PIPE FITTINGS



This 86-page Ladish catalog and technical data manual provides information vital to all who specify, purchase or install stainless steel pipe fittings.

Volume is tab indexed by type of fitting for quick reference to comprehensive tabulations of specifications, manufacturing standards and corrosion data.

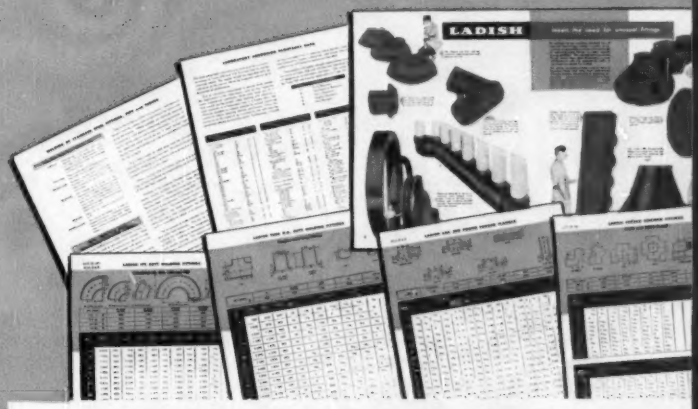
Use the coupon below to get this one master reference manual on a complete line of stainless steel pipe fittings.



ONE MASTER REFERENCE FOR COMPLETE DATA ON ...

- **BUTT WELDING FITTINGS (IPS AND TUBE O.D. TYPES)**
- **FLANGES – ASA, MSS, LIGHT TYPE AND CORROSION WEIGHT**
- **SCREWED AND SOCKET FITTINGS AND UNIONS**

... complete line covers the broad range of types, sizes, wall thicknesses and material specifications to meet virtually any requirement.



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Mail **THIS COUPON FOR YOUR LADISH STAINLESS STEEL CATALOG** *Today!*

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Please send me without cost or obligation the Ladish 86-page Stainless Steel Fittings Catalog and Technical Manual.

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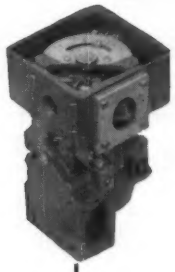
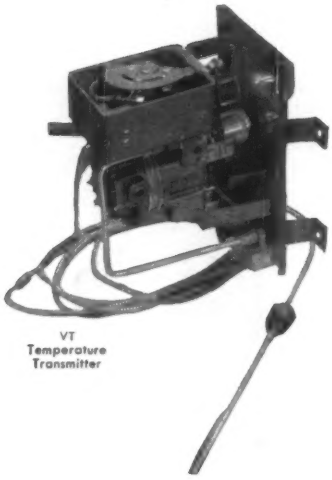
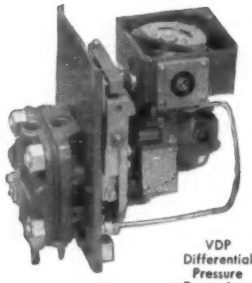


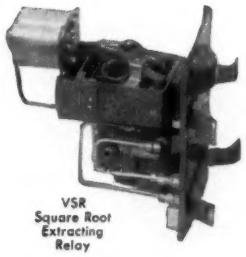
Common Pneumatic Component . . . the heart of each instrument



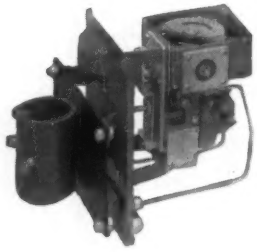
VT Temperature Transmitter



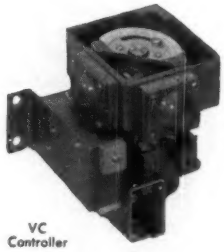
VDP Differential Pressure Transmitter



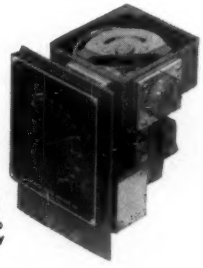
VSR Square Root Extracting Relay



Bellows Type VP Pressure Transmitter



VC Controller



VRR Ratio Relay

Rockwell-Built

Republic Vector Series Instruments

serve any process, cut costs too!

You can save substantial money when your control systems are based on Republic's Null-Balance Vector instruments. Each has as its "heart" an identical pneumatic component, with obvious advantages. Among these are interchange of parts, even among instruments performing entirely different functions. Besides involving a minimum spare parts inventory, this feature greatly simplifies personnel training.

Components shown demonstrate the depth of the Republic line. Differential pressure transmitters with 20-to-1 range adjustment . . . temperature transmitters with 10-to-1 range adjustment . . . pressure transmitters of ±.5% accuracy. We have ratio, totalizing, multiplying, squaring and square root extracting relays. Our all-purpose controllers feature proportional band adjustment of 2% to 500% and reset adjustment from 0.1 to 50 repeats per minute.

The Republic Engineer in your area will be glad to work with you on any control or measurement problem. Sales offices in principal cities throughout the United States and Canada. Call or write—with no obligation, of course.

REPUBLIC FLOW METERS CO.

Subsidiary of ROCKWELL MANUFACTURING COMPANY

2240 DIVERSEY PARKWAY CHICAGO 47, ILLINOIS

In Canada: Republic Flow Meters Canada, Ltd.—Toronto

Manufacturers of electronic and pneumatic instrument and control systems for utility, process and industrial applications.

Resilient and "Corrosion-proof" Garlock Gaskets

Teflon* JACKETED GASKETS for glass pipe flanges etc.

Resilience and deformability that are lacking in solid all-TEFLON gaskets are amply provided in Garlock TEFLON-jacketed gaskets. Fillers are available in practically any material for any application. Once the basic design has been selected, then the filler material and thickness are considered: rubber, asbestos, cork, corrugated stainless steel, etc. Call your Garlock representative or write for Garlock Folder AD-154.

Gaskets of TEFLON are another important part of the Garlock 2,000 . . . two thousand different styles of packings, gaskets, and seals for every need. The only complete line. That's why your Garlock representative can give you unbiased recommendations.

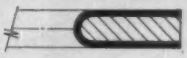
THE GARLOCK PACKING COMPANY
PALMYRA, NEW YORK
Plastics Div.: United States Gasket Co., Camden, N.J.

For Prompt Service, contact one of our 30 sales offices and warehouses throughout the U.S. and Canada.

BASIC DESIGNS

Slit Envelope. Flat Teflon stock slit from outside diameter to within ⅛" of inside diameter.

Milled Envelope. Flat Teflon stock machined from outside diameter to within ⅛" of inside diameter. Provides flush surface with pipe I.D. Reduces impedance to process flow.



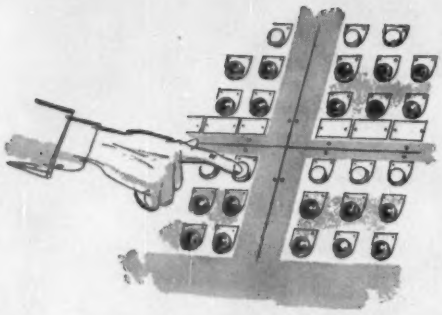
Formed Shield for large diameters and irregular opening such as elliptical manholes.

Double Jacket. Two jackets overlapping to protect O.D. as well as I.D. For glass-lined steel nozzles.

GARLOCK

Packings, Gaskets, Oil Seals, Mechanical Seals, Molded and Extruded Rubber, Plastic Products

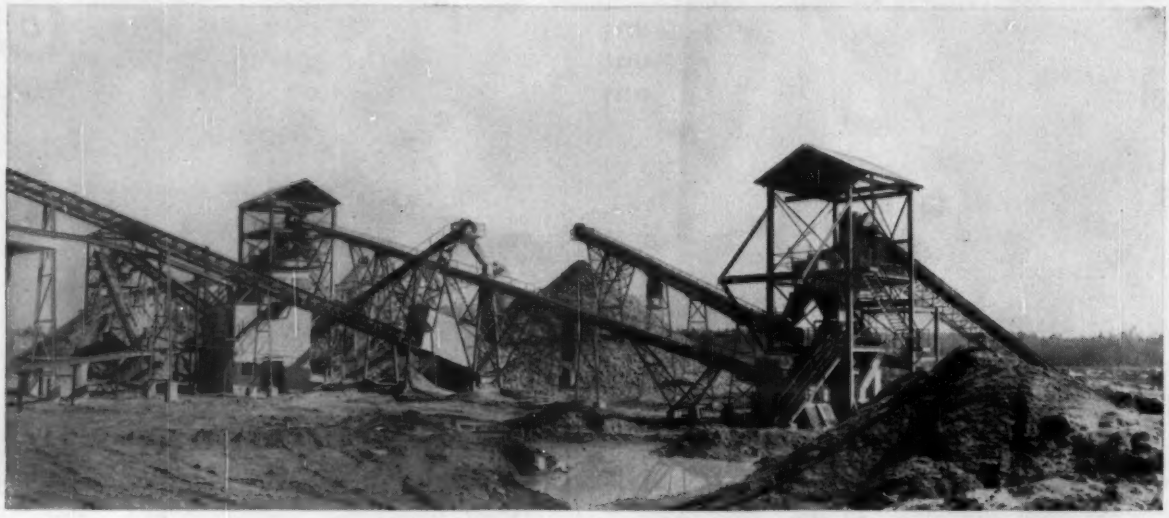
*Du Pont Trademark

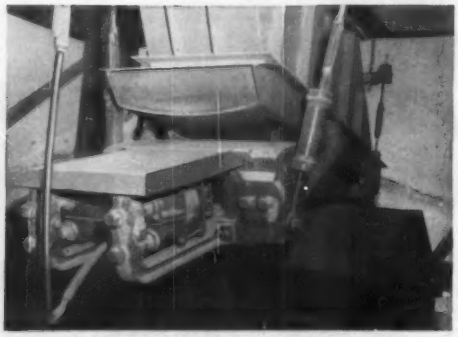


Fingertip control with

JEFFREY VIBRATING FEEDERS

...one man runs stone reclaiming operations, screening and washing plant, secondary crushers





Get details on how Jeffrey vibrating equipment and controls can simplify your materials handling job and save you money. Write for Catalog 930. The Jeffrey Manufacturing Company, 915 North Fourth Street, Columbus 16, Ohio.

THIS quarry produces both high calcium limestone and dolomite products. From a strictly operating standpoint, *one man at a Jeffrey-designed control panel* runs the screening and washing plant, two secondary crushers and reclaiming operations monitored by 15 Jeffrey vibrating feeders.

Jeffrey feeders under primary surge piles feed stone to the plant via reclaiming tunnel belt conveyor. Vibrating grizzlies with bars on 3" centers allow fine material to fall to belt conveyors ahead of coarser stone, insuring longer life for the belt.

Jeffrey vibrating feeders were also selected for reclaiming finished stone from stockpiles. At these feeders, flow of stone actuates a swing baffle which signals control panel operator that material is flowing properly. Even blends of stone can be obtained by regulating flow from stockpiles to reclaiming belt ... through remote-controlled Jeffrey vibrating feeders.

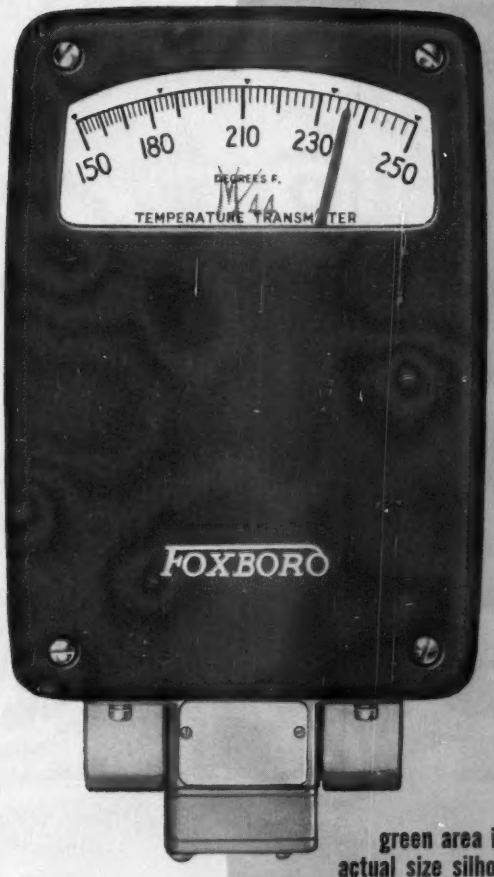
CONVEYING • PROCESSING • MINING EQUIPMENT...
TRANSMISSION MACHINERY...CONTRACT MANUFACTURING

JEFFREY

a compact, low-cost

INDICATING TEMPERATURE TRANSMITTER

engineered for fast, sensitive response under roughest field conditions — uses any filled thermal system.



green area is actual size silhouette of the new M/44

Here's a brand new instrument engineered specifically for its job of indicating and transmitting temperature.

The M/44 Indicating Temperature Transmitter offers the inherent simplicity of a motion balance instrument. Compact and lightweight (10 lbs.) its indicating scale and fluorescent red pointer are visible up to 20 feet away. The output pressure of the M/44 is transmitted to any remote 3-15 psi recorder, controller, or indicator.

The M/44 is made with standard performance-proved Foxboro components, simply and conveniently arranged in a weather proof steel case. Changing range or type of thermal system can easily be done in your own plant.

Thanks to its rugged construction, the new M/44 is unaffected by vibration, sudden shock, or corrosive atmosphere. Even in the event of air supply failure, this instrument continues to indicate process temperature.

Ask your Foxboro Field Engineer about this new instrument. Or write for Bulletin 13-28A, The Foxboro Company, 3611 Neponset Ave., Foxboro, Mass.

CHOICE OF THERMAL SYSTEMS

Foxboro M/44 Transmitters are available with any filled thermal system. These classes are suggested for particular range characteristics:

Class II Vapor Pressure (100° to 600°F)
Lowest cost, fastest response, highest sensitivity. Recommended for all installations within this range except when the measured temperature crosses ambient temperature.

Class IA & IB Liquid Expansion (−250° to +600° F)
Good response, good sensitivity, uniform scale. Uses smallest bulb of any filled thermal system.

Class III Gas Pressure (−450° to +1000° F)
Applicable to ranges beyond the limits of other filled systems. Uniform scale. Bulb has long sensitive section; permits useful averaging measurements.

FOXBORO
REG. U.S. PAT. OFF.

TEMPERATURE MEASUREMENT AND CONTROL

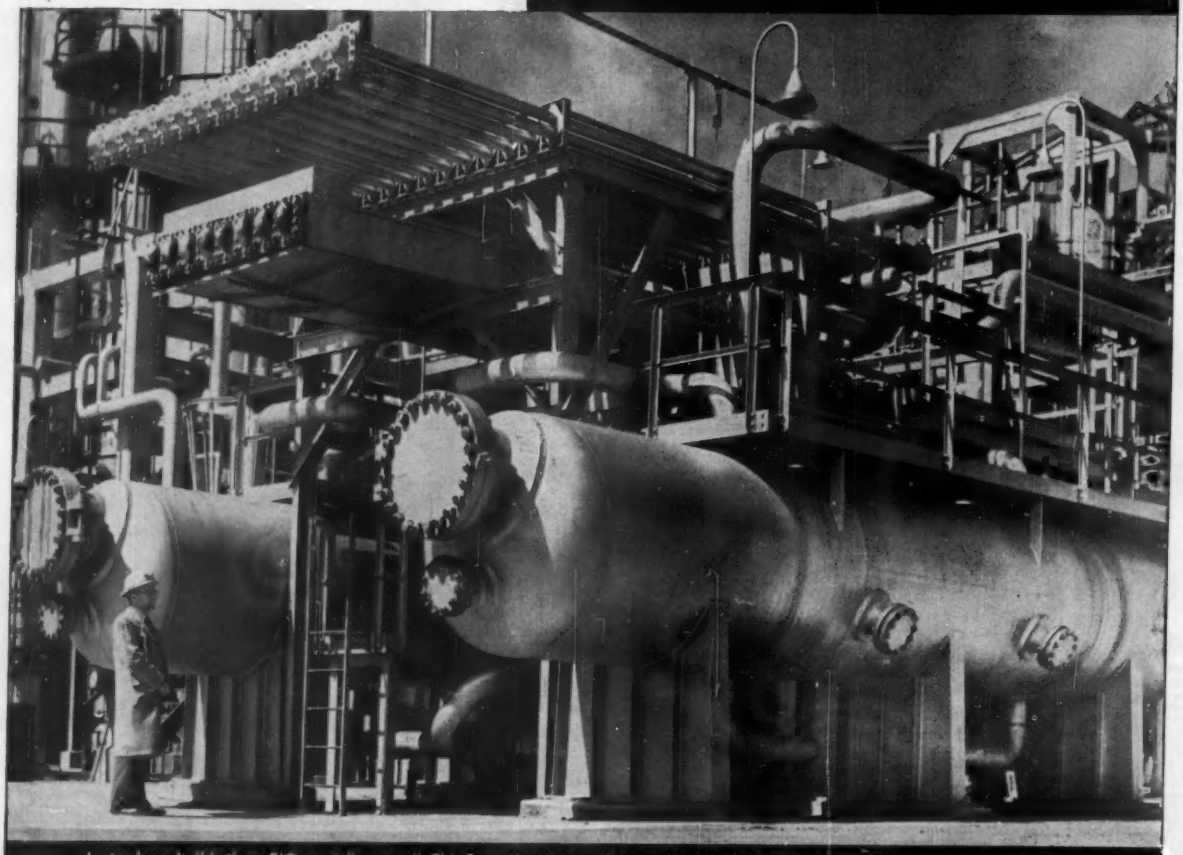
WHERE YOU DON'T DARE TAKE A CHANCE

...choose **LECTRODRYER®** for dependable DRYing

This huge Lectrodryer *must* stay on-stream until turn-around time. It dries recycle gas in the platforming operation, where moisture must not get through to foul the catalyst.

The engineers who specified this Lectrodryer based their selection on long experience with adsorbent dryers. They knew they could depend on Lectrodryers to provide efficient, dependable drying, year after year.

Whether your drying needs are for thousands of feet per hour or only a few—for drying air, gas or organic liquid—there is a Lectrodryer to do the job. Let our engineers help you select the *right* equipment for your particular drying needs. Pittsburgh Lectrodryer Division, McGraw-Edison Company, 303 32nd St., Pittsburgh 30, Pennsylvania.

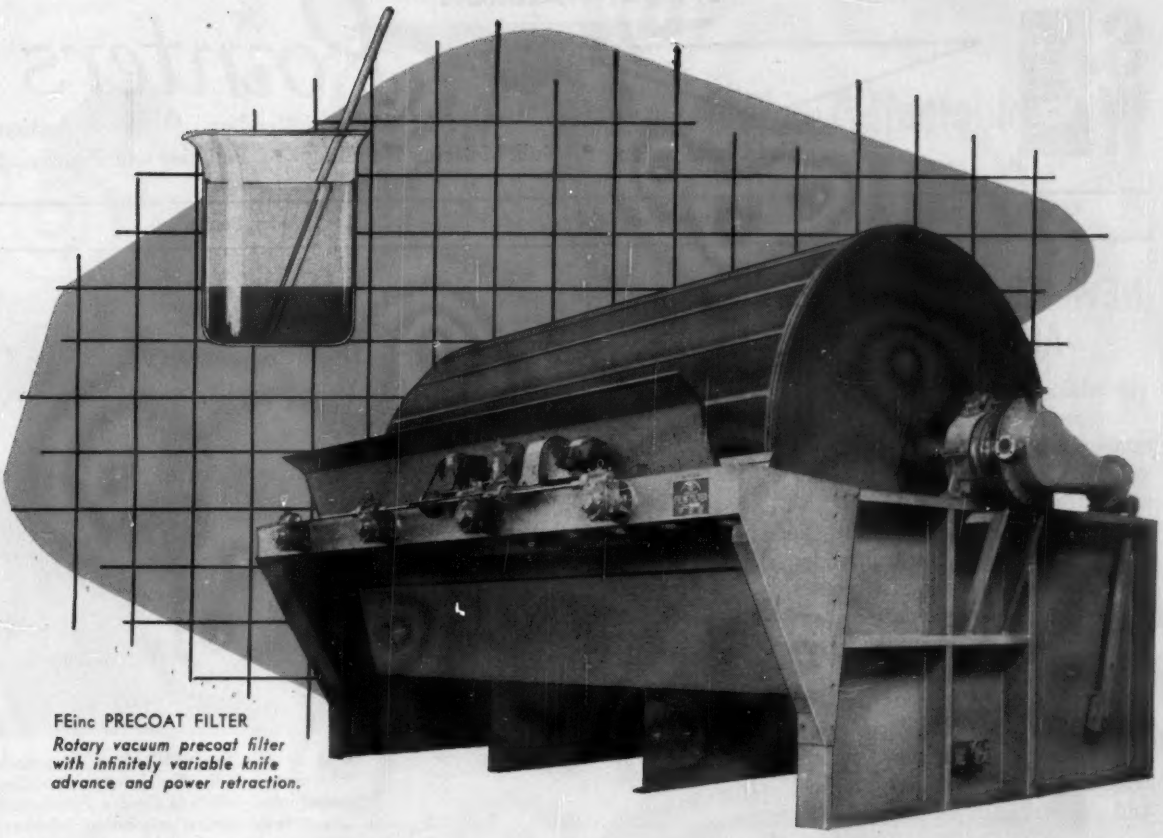


Lectrodryer builds them BIG as well as small. This Type H unit is working at Sinclair Refining Company, Marcus Hook, Pennsylvania.

Leading industries look to

Lectrodryer® McGRAW EDISON

World's First and Foremost Manufacturer of Commercial and Industrial Adsorbent Dryers



FEinc PRECOAT FILTER
Rotary vacuum precoat filter with infinitely variable knife advance and power retraction.

Custom Filter Design

BEGINS WITH YOUR FILTRATION PROBLEM

Your processing requirements are king at FEinc. They dictate the type of filter to be built, its size, the materials used, and the special refinements necessary to assure highest possible operating efficiency.

For example, a FEinc Precoat Filter designed to meet your particular needs pays off fast in trouble-free operation, dryer cake discharge and high clarity of effluent.

If you require higher output in limited floor area and a long filtration cycle coupled with the above advantages, FEinc *custom design* can give it to you.

Send us your filtration problems. Specific recommendations provided without obligation.

See our insert in Chemical Engineering Catalog

For a Bigger Yield **FE INC.®**

FILTRATION ENGINEERS
AMERICAN MACHINE AND METALS, INC.
EAST MOLINE, ILLINOIS

STRING HORIZONTAL SCRAPER

SPECIALISTS IN LIQUID-SOLIDS SEPARATION

SPROUT-WALDRON Pointers

for Mixing and Blending • Size Reduction
Size Classification • Bulk Materials Handling • Pelleting and Densifying

Published in the interest of better processing by Sprout, Waldron & Co., Inc., Muncy, Penna.

NEW PELLET COOLER AND DRYER

Modification of the patented Rotaircool®, developed for the economical cooling, drying and conveying of pellets, has been recently announced.

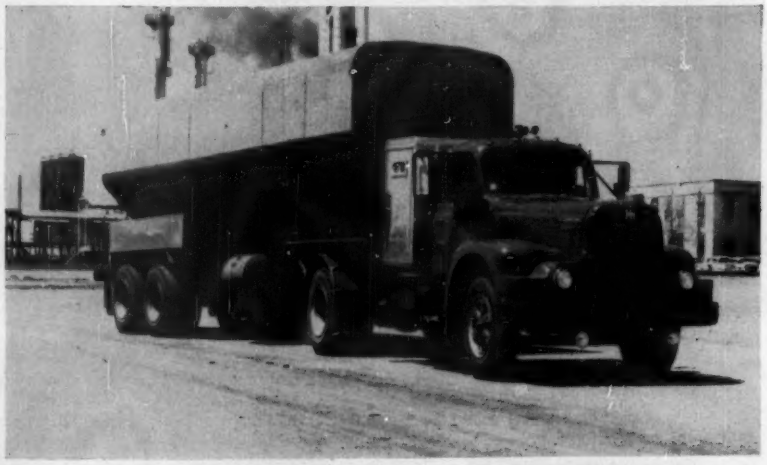
Major redesign feature is the use of a compact rotary airlock feeder beneath the tank to receive the cool or dried pellets and discharge them as required. Handling of the pellets from the pelleter to the inlet of the Rotaircool is by means of the Sprout-Waldron Pneu-Vac® negative pressure air handling system which keeps pellet breakage, dust and maintenance at a minimum.

Sprout-Waldron Industrial Rotaircool for cooling, drying and pneumatic conveying of pellets.

By adding heating coils just prior to the pellet inlet, the Rotaircool® system is equally adaptable for heating or cooling. Further details in Bulletin 202.

PRACTICAL PNEUMATIC CONVEYOR DESIGN

A technical article by the Chief Engineer of our Materials Handling Division. It tells how to select, operate and maintain pneumatic systems for transporting dry, bulk materials. Positive, negative and combination systems are illustrated and described. Ask for Bulletin I-28.



One of five Sprout-Waldron Pneumatic Aluminum Bulk Trucks for handling polystyrene pellets in Cosden Petroleum's new "curb service marketing" delivery concept. Note Cosden's modern 32,000 barrel custom refinery in background.

SPROUT-WALDRON BULK TRUCK HANDLES POLYSTYRENE PELLETS

A recent announcement by officials at Cosden Petroleum Corporation, Big Spring, Texas of a new delivery concept, "curb service marketing" is arousing considerable interest throughout the plastic industries. The revolutionary marketing plan involves a delivery of polystrene pellets by special highway transports direct from the purchasing plant to the customer.

The key to the new concept is a group of five 28' pneumatic aluminum bulk trailer units designed and built by Sprout-Waldron. Each of these trailers has a capacity of 1,182 cubic feet which is equivalent to 34,000 lbs. of polystyrene pellets. The high powered unloading system permits delivery to the customer at the rate of 30 tons per hour. Delivery and storage in bulk cuts down on fringe expenses such as unloading, warehousing, multiple handling and contamination. Bulk storage also permits instant inventory determination. Storage bins can be located at the most suitable point in the plant since the pneumatic unloading system built into the trucks permits delivery anywhere a pipe can be run.

Recent completion of the new polystyrene plant is said to make Cosden Petroleum the first producer able to integrate all phases in the manufacture of this basic material. Both general purpose crystal polystyrene and high impact polystyrene are being produced. The styrene monomer used in manufacturing polystyrene is produced in an adjacent plant also owned and operated by Cosden.

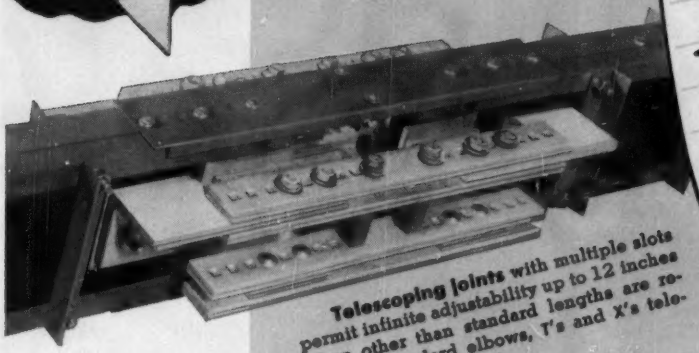
CP/108

Here's Why Square D's New Adjustable

ALUMINUM FEED-IN DUCT

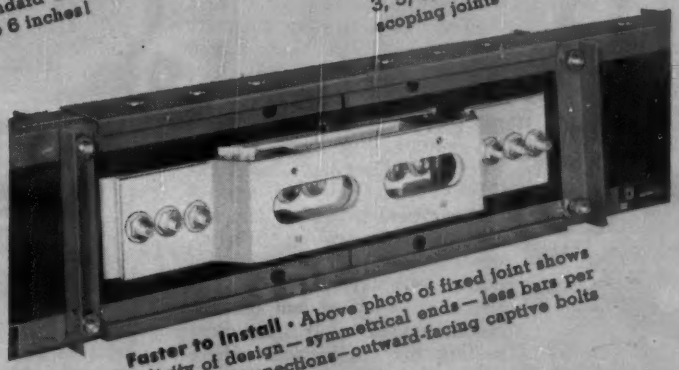
makes a lot of sense to me!

Needed-Rush!
85 feet; 3½ inches
1000 Amp, 3ϕ4 wire
Feed-in Duct

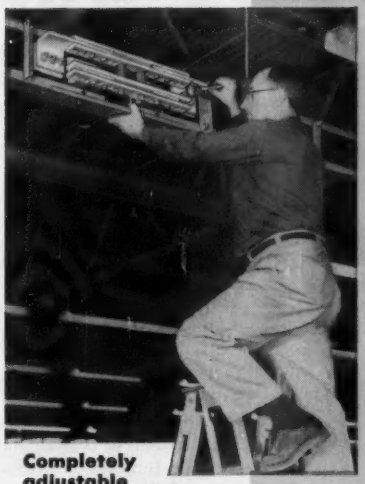


Telescoping joints with multiple slots permit infinite adjustability up to 12 inches when other than standard lengths are required. Standard elbows, T's and X's telescope up to 6 inches!

Fast delivery because any length requirement can be met with standard 3, 5, 7, or 10 foot lengths, plus telescoping joints



Faster to Install • Above photo of fixed joint shows simplicity of design—symmetrical ends—less bars per phase—fewer connections—outward-facing captive bolts



Completely adjustable after it's hung. For example, if two ends terminate 6½ inches apart, connection can still be made with a telescoping joint

Totally enclosed for safety —at no price premium. No de-rating necessary. Square D's design eliminates need for ventilation

MORE DESIGN FEATURES

- Thinnest cross-section available! Tight spots, pipes and structural members present less problems
- Easy transposition of phases, using standard telescoping joint parts, for maintaining balanced voltage on long runs
- Certified short circuit tests by an independent testing laboratory have proved the superiority of Square D's continuously-supported bus design

Write for the complete story
Address Square D Company, 6060 Rivard Street, Department SA, Detroit 11, Michigan

NOW...EC&M PRODUCTS ARE A PART OF THE SQUARE D LINE

SQUARE D COMPANY

News and Notes on...
Good Packing Practice

JOHNS-MANVILLE JM PRODUCTS

Maintenance and Design Hints from Johns-Manville Packings and Textiles Dept.

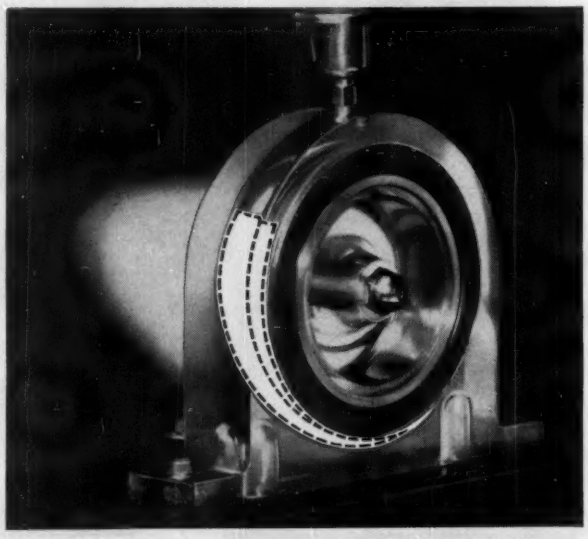
Subject of the month: Effective Shaft Sealing

Question: What is an economical way to seal in or seal out with maximum efficiency?

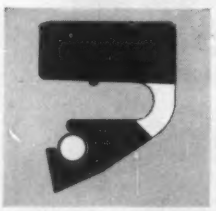
Whether the shaft bearing is of the sleeve, roller, or ball type . . . seals should meet two basic requirements: (1) provide a tight seal despite light applied pressure, and (2) resist abrasion and corrosion.

The transparent unit shown at the right was created by research engineers to study this subject of effective sealing . . . witness the performance of J-M seals in development stages. It helped them perfect the versatile, dependable line of J-M Clipper® Seals that serve many industries.

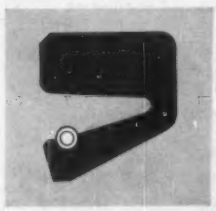
In this unit, Clipper Seals are mounted on a transparent cylinder, just as in a bearing cavity. The heel of the seal provides the rigidity essential for a press fit. The lip is flexible and soft so as to snug the shaft with a minimum of friction. Thus it acts like a gasket and effectively stops leakage.



HERE ARE JOB-TESTED RECOMMENDATIONS FOR COMMON SEALING APPLICATIONS:

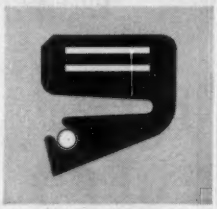


For General Service—Type LPD All Purpose. This line-contact Clipper Seal provides long life and maximum sealing effectiveness under a wide range of equipment variables. Its synthetic rubber base compound is recommended by J-M for most sealing lip applications where combined ambient and operating temperatures reach 250°F and higher. It seals practically all fluids . . . has proved highly effective against oils and greases, hot and cold water, air and many other gases and vapors. And it maintains its high efficiency despite time, high temperatures, and adverse conditions.

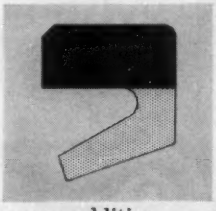


For Small Clearances—Split Clipper Seals. Split Clipper Seals have wide acceptance as temporary replacement seals for equipment with space or design limitations . . . to save costly downtime. Installation in inaccessible space is relatively simple and speedy. They are practically fracture-proof . . . stand up under the rough treatment . . . can be forced into position around the shaft. They give long-term, efficient sealing until a major overhaul permits replacement with solid seals.

For further data on Clipper Seals write for Book PK-71A. Address: Johns-Manville, Box 14, New York 16, N. Y. In Canada: Port Credit, Ontario.



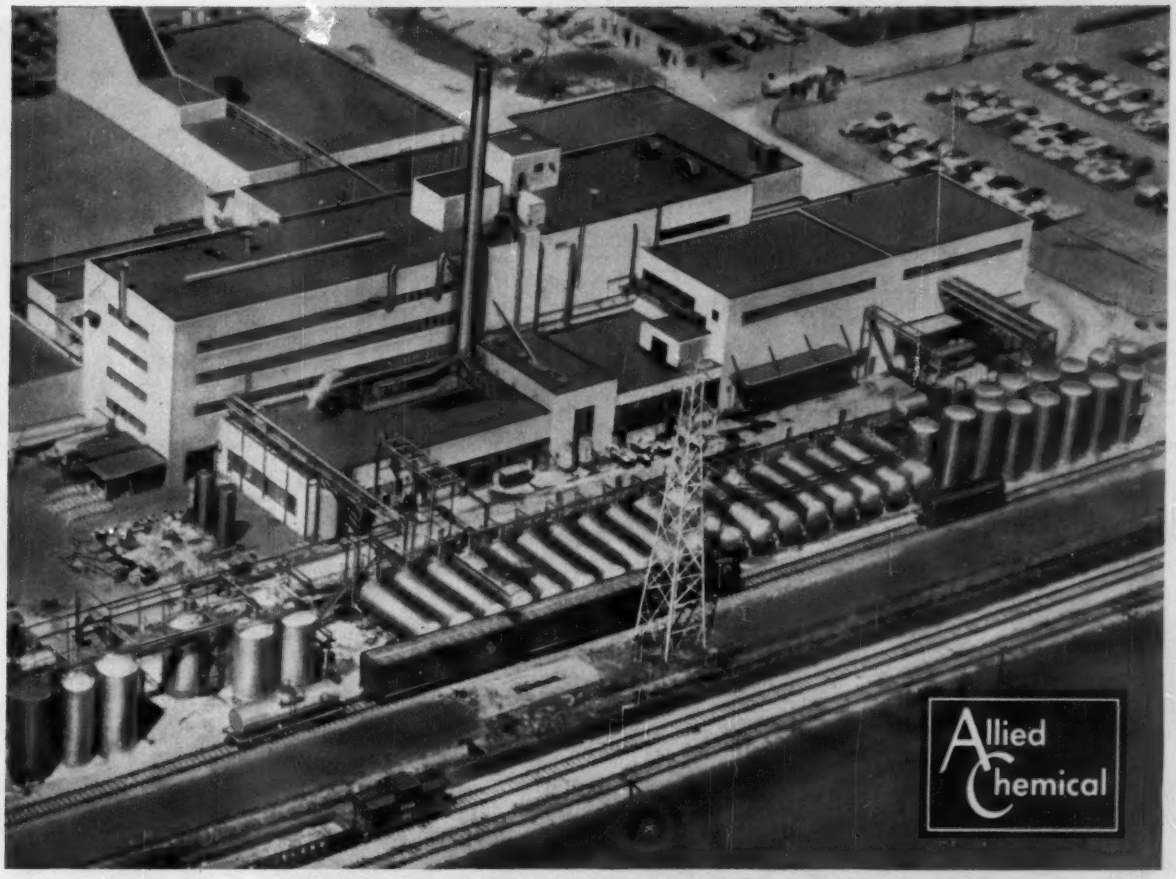
For Continuous High Speed Operations—Type LPD Metal-Reinforced. This Clipper Seal, incorporating a metal reinforcement, is ideal for use in continuous high speed and extremely abusive service such as encountered in the steel industry. It expands and contracts with the chuck in which it is installed. It is a combination of two synthetic rubber base materials that are highly resistant to cracking, hardening and shrinking.



For Small Shaft Diameters—Type SS Springless. Here's the Clipper Seal designed for smaller cavities. It is made of a selected synthetic rubber base compounded to minimize swell and deterioration in corrosive applications where chlorinated solvents, lubricating oils carrying severe additives, or similar aggressive fluids must be sealed. It is a complete part in itself—contains no metal spring. No spring is required because this seal is designed to exert sufficient lip interference on the shaft to compensate for wear over a long period of time.

JOHNS-MANVILLE

100 YEARS OF QUALITY PRODUCTS . . . 1858-1958



Polyester and Phenolic Resins Plant—Toledo, Ohio
Plastics and Coal Chemicals Division, Allied Chemical Corporation

COORDINATION COUNTS

The Plastics and Coal Chemicals Division required installation of its new Polyester and Phenolic Resins facilities without plant shutdown or interruption of other production.

Synchronizing its operations with those of the client, Catalytic completed the job as required . . . ahead of time and under the budget.

With Catalytic—On Time—On Budget is far more than just a slogan.

CATALYTIC
CONSTRUCTION COMPANY

Philadelphia 2, Pennsylvania
New York, New York
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Tulsa, Oklahoma

In Canada: Catalytic Construction of Canada, Limited; Sarnia, Ontario; Toronto, Ontario; Montreal, Quebec.

Catalytic *On-Time . . . On-Budget* Services for the metallurgical, chemical, petrochemical and oil refining industries: Project Analysis; Process Development; Process Design; Economic Studies; Engineering; Procurement; Construction.

ALUMINUM GATE VALVES

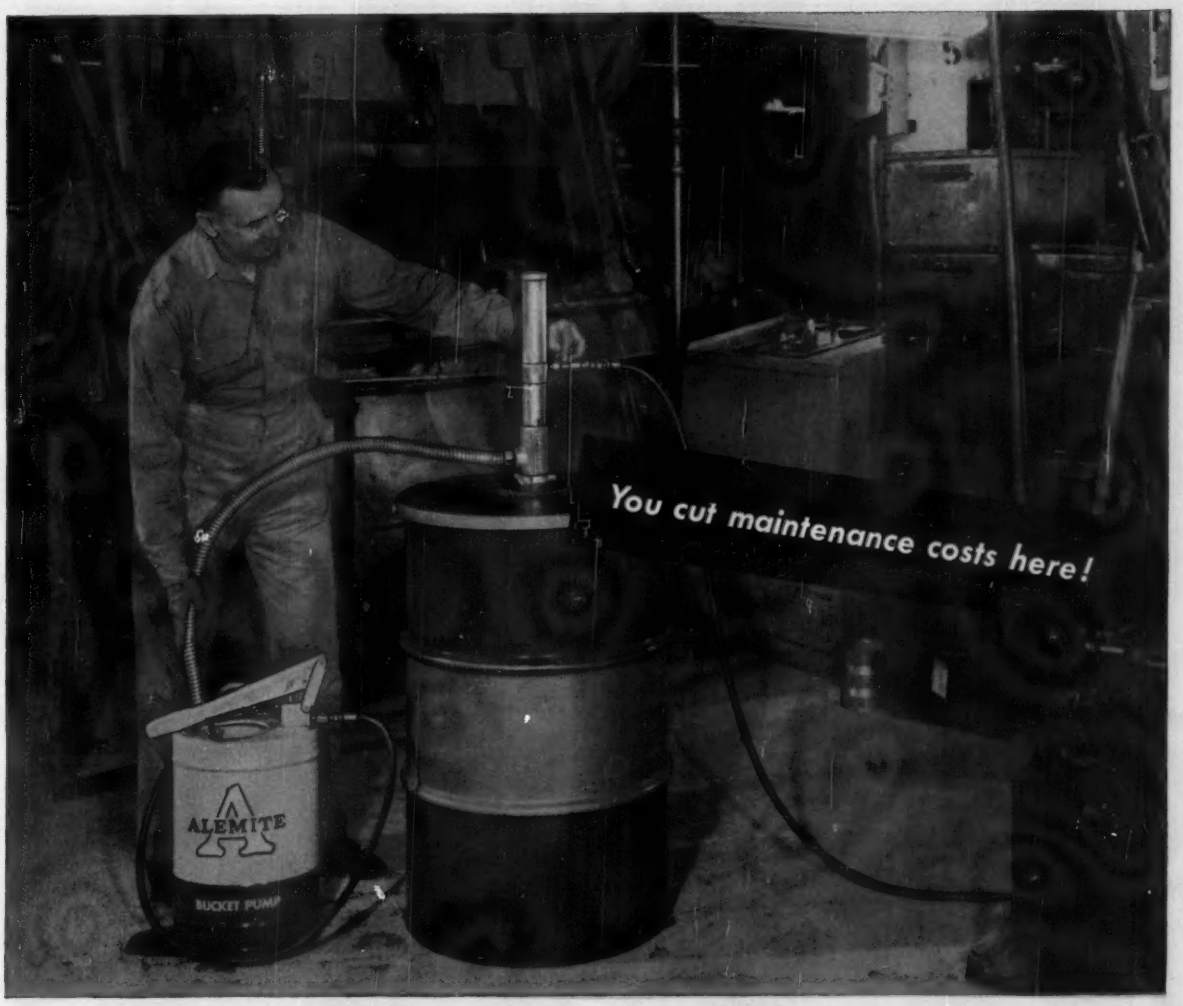
by Darling

Darling gate valves of aluminum alloy offer all of the unique, extended-life features inherent with the Darling fully revolving double disc, parallel seat principle... for performance that assures unmatched economy... and freedom from leakage, trouble and downtime!

These Darling aluminum alloy valves are now available in ½" through 24" sizes. Write for full details, specifying your particular service requirements.

DARLING VALVE & MANUFACTURING CO.

WILLIAMSPORT 3, PA.



Alemite Power Transfer of Lubricants Is 63% Faster Than Hand Method!

Wherever old-fashioned hand methods are used to transfer lubricants from original drums to other containers, time and money are wasted!

This high-speed, air-powered Alemite Transfer Pump transfers 37 pounds of pressure gun grease per minute, direct from original drum to loader pump, bucket pump or power gun. This gives you 63% faster transfer than by hand! And lubricant is always sealed—fully protected against mess, waste and contamination.

Pump also handles alcohol, cutting oils, kerosene—almost any non-corrosive, non-abrasive fluid used by the drum. Synthetic rubber air piston requires no oiling. Fully adjustable delivery rate . . . weighs only 15½ pounds!

Step up to fast-moving, time-saving transfer of fluid and semi-solid materials. Check Alemite's complete line of lubrication equipment for industry.

Symbol of SW Excellence

ALEMITE
DIVISION
STEWART-WARNER
CORPORATION

1850 Diversey Parkway, Chicago 14, Illinois

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Please send me your complete catalog of Alemite industrial lubrication equipment.

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City ..... Zone ..... State .....

The Answer to your toughest tank lining problems

TYGON

flexible – plastic

•

TOPS IN CORROSION-RESISTANCE

PROVEN in hundreds of the toughest possible applications during the past eighteen years, flexible Tygon plastic tank linings offer more value today than ever.

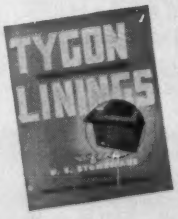
Greater toughness; even better chemical resistance, particularly to chromic and other highly oxidizing acids; longer life.

This better Tygon lining (Formulation 105-A) represents a major step forward in the development of heavy duty plastic sheetings for corrosive service. Tygon linings are now extruded, not calendered. They are completely free of "laminations" — cannot "peel" in service. Under continuous immersion these better Tygon linings show negligible extractibility.

Available in 3/32" and 3/16" thicknesses, Tygon can be installed by strategically located licensed applicators quickly and inexpensively.

For that next "tough" tank lining problem — ask for, insist on — TYGON.

311F



This booklet tells the "down-to-earth" facts about Tygon. Where and how to use it. When not to use it. A valuable reference for every engineer faced with corrosion problems. Free on request. Write for your copy today! Ask for Bulletin TL-526-R. Address: Plastics & Synthetics Division, The U. S. Stoneware Co., Akron 9, Ohio.

U. S. STONEWARE

AKRON, OHIO

Tygon is the registered trade-mark of The U. S. Stoneware Co.

DEVELOPMENTS . . .

NOVEMBER 3, 1958

Chementator

C. H. CHILTON

Hyperpure nickel, containing only ppm. of cobalt, can be made by tri-iso-octyl amine extraction of HCl solutions of Ni-Co. Bureau of Mines is readying a pilot plant at Salt Lake City which will also turn out Ni-free cobalt.

A staggering $150,000 per employee is investment in British American Oil Co.'s new refinery at Port Moody, B. C. The $25-million facility will be staffed by about 160 employees.

Agfa AG., Leverkusen, Germany, has a new black-and-white film with an ASA speed of about 2,000. This means that a portrait can be taken by matchlight in an otherwise dark room at f.4 and 1/50 sec.

Plug flow boosts reactor yield

Study of reaction equilibrium and kinetics is paying off with a 15% increase in isobutane output from Shell Oil's 3,500-bbl./day butane isomerization unit at Wilmington, Calif. And plans are under way to duplicate these results at Wood River, Ill., and in Curacao.

Accounting for the boost in yield is a new isomerization reactor design. Although design details can't be published yet, Shell explains that the new reactor provides close approach to plug flow, that back-mixing is all but eliminated.

Shell's original isobutane process—in which butane is treated in liquid phase with an aluminum chloride-antimony trichloride catalyst—used a single stirred vessel. Conversion was about 51% per pass.

However, theoretical studies showed that equilibrium at process temperature of 195 F. would permit up to 71% conversion. Internal recirculation in the reactor was robbing Shell of additional isobutane output.

This was demonstrated when Shell engineers put two stirred reactors in series. But development of the single plug-flow reactor soon rendered the series setup obsolete. Today's yield of 60% represents optimum compromise between conversion and throughput.

In light of the present octane race in motor gasolines, Shell's achievement is especially timely. Isobutane is needed to make alkylate, a high-octane blending component. Shell will include its new-found reactor know-how in any new isobutane plants built by Shell or by its licensees.

Wet oxidation scores big success

Enthusiastic about its pilot-plant experience this year with Sterling Drug's Zimmermann process for wet oxidation of wastes (*Chem. Eng.*, Aug. 25, pp. 117–120), Chicago's Metropolitan Sanitary District plans to put the new process to work next year in a big way.

Although no contracts have yet been signed, all indications now are that MSD will

New CROUSE-HINDS EXPLOSION-PROOF MERCURY VAPOR LIGHTING FIXTURES

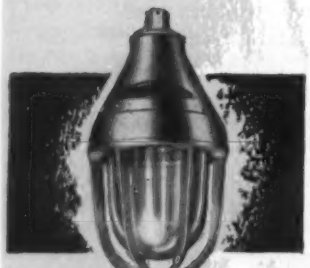
For dependable security at low operating cost in hazardous locations . . .

- *where long burning hours without interruption are involved, month in, month out*
- *where labor cost or trouble of relamping is an important factor*
- *where maximum lighting output calls for maximum economy in power consumption*

The longer life of mercury vapor lamps is well established: 7000 hours, *vs.* 1000 hours for incandescents. Light output is 2.5 times greater; 55 lumens/watt, *vs.* 22 lumens/watt for incandescents.

The new EV's place these economies within easy reach. As with all Crouse-Hinds explosion-proof devices, EV's are heavily constructed to withstand the pressure of internal explosions without rupturing. Gas-tightness is *not* a requirement for their safe performance. Flame-tight joints prevent the escape of flames to flammable atmospheres.

- *For full information, call your Crouse-Hinds distributor, or write for catalog sheet.*



TYPE EVA Explosion-Proof Lighting Fixture

Available with or without guard, or reflector (dome, deep bowl, shallow bowl, angle, or high bay)

250 Watt— National Electrical Code: Class I, Groups C & D

400 Watt— Class I, Group D

CROUSE HINDS

MAIN OFFICE AND FACTORY: SYRACUSE, NEW YORK

Crouse-Hinds Company of Canada, Ltd., Toronto, Ont.

• CONDULET® ELECTRICAL EQUIPMENT (Explosion-Proof and Conventional) • FLOODLIGHTING
• TRAFFIC CONTROL SYSTEMS • AIRPORT LIGHTING and WEATHER MEASURING EQUIPMENT

These products are sold exclusively through electrical distributors. For application engineering help, consult one of the following offices: Baton Rouge Birmingham Boston Buffalo Chicago Cincinnati Cleveland Corpus Christi Dallas Denver Detroit Houston Indianapolis Kansas City Los Angeles Milwaukee New Orleans New York Omaha Philadelphia Pittsburgh Portland, Ore. Salt Lake City St. Louis St. Paul San Francisco Seattle Tulsa Washington Resident Representatives: Albany Atlanta Baltimore Charlotte Chattanooga Jacksonville Reading, Pa. Richmond, Va. Shreveport

start construction early next year on facilities to handle 200 tons/day of sewage sludge. Proposed flowsheet shows four 1,500-psi. reactors in parallel, each handling 50 tons/day.

Estimated cost of the plant is $6–8 million, vs. $25 million or more for a conventional sludge disposal plant. Operating costs are put at $10–12/ton of sludge solids, vs. present $30–45/ton. As an MCD spokesman told *CE*, "After the results we've gathered in the pilot plant this year, we just can't afford not to go ahead with a bigger Zimmermann facility."

The Chicago pilot plant can handle 2 tons/day of sludge. Reactor is a high-carbon steel vessel, 2 ft. dia. and 20 ft. high, with 1½-in. wall thickness. It operates at 1,200 psi. and about 500 F.

Wet combustion reaction is noncatalytic, simply involves mixing air and waste liquor at a high-enough pressure and preheating to a point (at least 300 F.) where reasonably fast oxidation of the dissolved and suspended organic matter can start. End products are steam, nitrogen, carbon dioxide and a clean, odorless ash with a specific gravity of 2.2.

The Zimmermann process is not limited to sewage disposal. First commercial plant, expected on stream by early 1959, will handle waste sulfite liquor at a 500-ton/day Norwegian pulp mill, will yield a dividend of 236,000 lb./hr. of valuable process steam.

Hydrogen, ethane power fuel cells

Allis-Chalmers has unveiled a hydrogen-oxygen fuel cell that is claimed to have the highest voltage-to-volume ratio yet achieved in science's 150-year-old quest for economical means of converting chemical energy directly to electricity.

A-C's most advanced unit is a metal box 10 in. long, 4 in. wide and 8 in. deep. It is divided into 24 individual, series-hooked cells by flat metal electrodes immersed in KOH electrolyte. Unit delivers 24 v. when operating at room conditions and can light up two 15-w. bulbs.

Main difference between the new cell and National Carbon's H_2-O_2 cell (*Chem. Eng.*, Dec. 1957, pp. 154–158) is that National Carbon uses hollow graphite electrodes. A-C won't specify what catalyst coating is applied to its electrodes (neither will NCC), but admits that platinum black is one of several which have worked okay.

Research Director H. K. Ihrig emphasizes that the A-C cell is still a laboratory device and declines to discuss its present efficiency. He believes that this type of cell should ultimately operate with 80% fuel efficiency and deliver something over 1 kw./cu. ft. These figures are roughly comparable with National Carbon's cell, now being used to power portable radar sets for the Army.

Another class of fuel cell—the hydrocarbon cell—is making news also. Esso Research & Engineering claims a "major breakthrough" in an ethane-air cell. Esso refuses to divulge technical details, pointing out, like A-C, that its cell is strictly a laboratory model. Its power output, however, is only in the "flashlight-bulb" range.

Magnetic ion exchange, anyone?

Goal of joint research by Dow Chemical and Utah Construction Co. is an ion exchange resin that could be magnetically recovered from an ore slurry. This would be done by putting some sort of magnetic material into the resin.

The proposed technique would simplify the processing of uranium ores by ion exchange. Resin could be slurried with the ore, then separated magnetically. This would eliminate the present need for screens, baskets, thickeners and clarifiers.

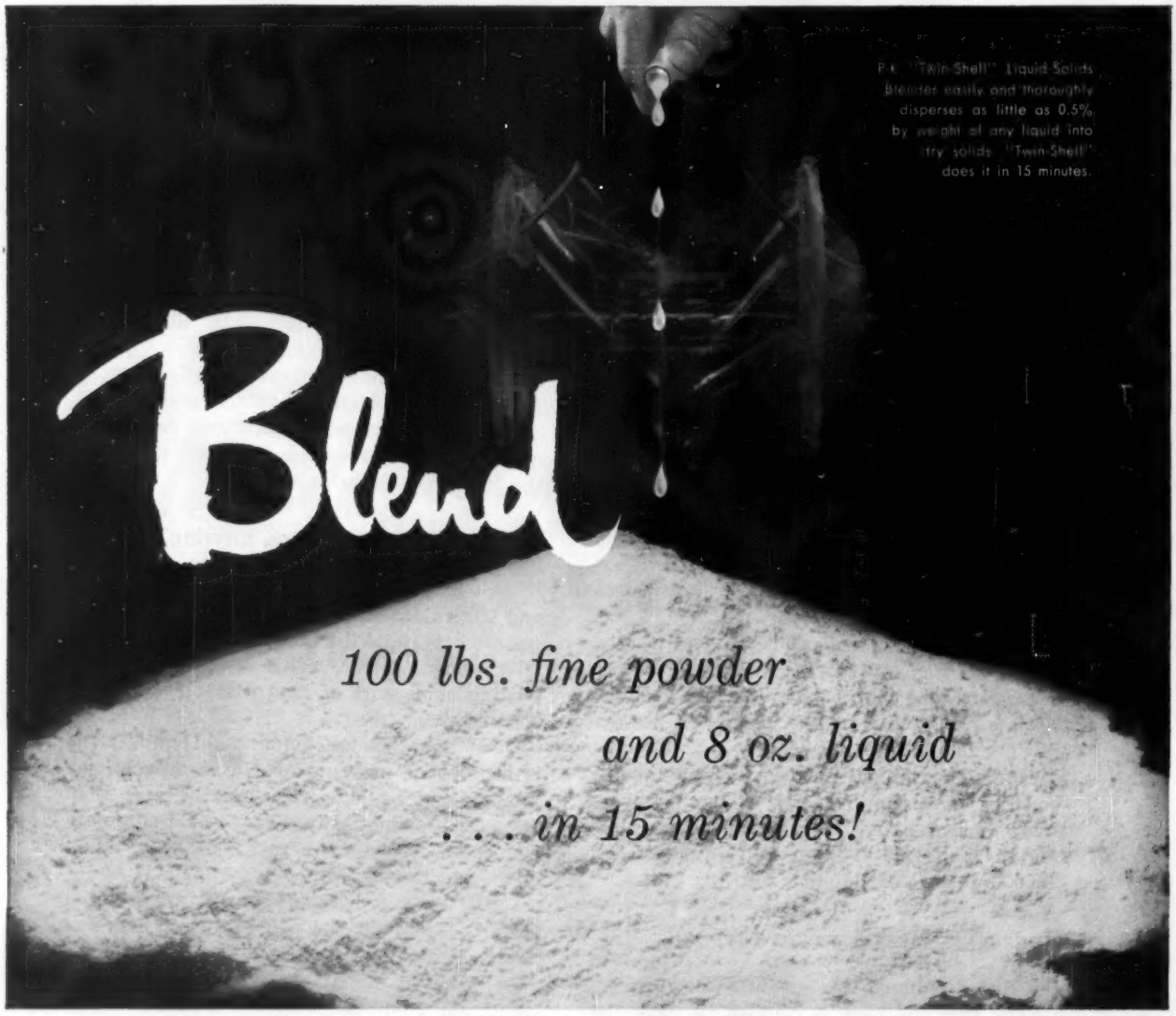
Utah Construction's interests are oriented towards uranium; the San Francisco firm has designed and built two ore processing mills. Dow sees the possibility of marketing magnetic ion exchange resins for many other industrial applications.

New dialyzers use vinyl membranes

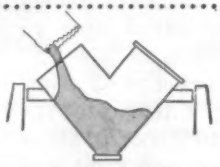
Development work carried out by a leading copper refiner on use of dialysis to separate sulfuric acid from metal sulfates has spawned a new line of commercial dialyzers which promises to extend the industrial uses of dialysis into the processing of acids.

Graver Water Conditioning Co., New York, now offers compact filter-press-type dialysis units providing up to 2,000 sq. ft. of membrane area. A prototype unit went into service in an Eastern copper refinery in August to separate sulfuric acid from dissolved nickel sulfate. Two larger units have since been added to recover sulfuric acid from copper

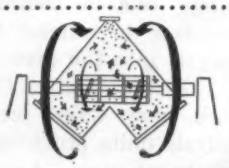
(Continued on page 52)


P-K "Twin-Shell" Liquid-Solids Blender easily and thoroughly disperses as little as 0.5% by weight of any liquid into dry solids. "Twin-Shell" does it in 15 minutes.
Blend
100 lbs. fine powder
and 8 oz. liquid
. . . in 15 minutes!

With the P-K "Twin-Shell" Blender the process industries can eliminate such post-blending operations as pulverizing and screening, with their time-consuming materials handling. Blending time itself is cut from hours to minutes. And some hitherto impossible blends are achieved easily with the P-K "Twin-Shell." Here's how "Twin-Shell's" unique design speeds processing:

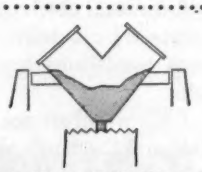


CHARGE DRY SOLIDS through top of either shell. Optimum charge level for most materials is about 65% of total shell volume.



TUMBLE AND AERATE. As shell revolves, rapidly spinning wire cage intensifier breaks up agglomerates, literally creates dust storm in material.

ADD LIQUID. Centrifugal force sprays atomized liquid from periphery of control discs on Liquid-Feed Bar into finely dispersed solids.



DISCHARGE PRODUCT easily through apex of shells. Accessibility of interior and easy removal of Liquid-Feed Bar speed cleaning.

See this new concept in blending! Accept this invitation...

Get new ideas for your blending process at P-K's Pre-Test Lab

P-K Process Executive welcomes visitor to Pre-Test Lab at East Stroudsburg, Pa. Lab is equipped and staffed to make, or help you make, conclusive tests of blenders with your own materials.

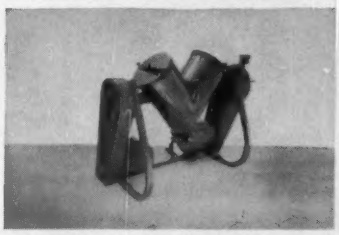
Phone Stroudsburg 820 and arrange to make comparison tests – using your own formulations – at P-K's Pre-Test Lab.

P-K makes practically all kinds of blenders – conventional types as well as the radically different "Twin-Shell." Thus, P-K can give you impartial help in selecting the correct blending process for your needs.

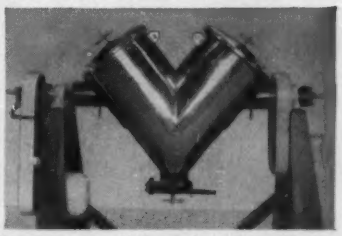
But, blending is full of variables; don't decide on *any* blending equipment or process until you pre-test it with your own formulations. The Pre-Test Lab offers you an opportunity to do this with the aid of skilled blending technicans and proper equipment . . . and without obligation, of course.

You simply bring or send your materials to the Lab. Here the correct blending procedure and equipment for *your* job are determined by extensive tests. You receive a comprehensive report that can become the basis for an informed selection.

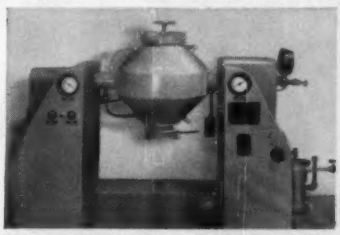
TEST YOUR MIX WITH EQUIPMENT LIKE THIS



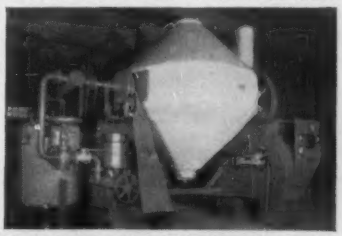
"Twin-Shell" Liquid-Solids laboratory models are made in transparent Lucite or stainless steel, in 8 and 16 quart sizes.



Production models of the "Twin-Shell" blender range up to 50 cu. ft. capacity. (Intensifier and Liquid-Feed Bar optional.)



Vacuum Tumble Dryers by Patterson-Kelley are available in sizes down to the standard 1 cu. ft. capacity lab model.



Production models of the Vacuum Tumble Driers have capacities up to 150 cu. ft. Come factory aligned, piped, instrumented.

You're invited

to pre-test your own formulations at the Pre-Test Lab. Write – or better yet, phone – Russell Dotter at P-K to set a date. (The number: Stroudsburg 820.) He will tell you how much of your materials to bring and will give you other details.

If you can't spare the time, send your materials anyway. But try to see the tests for yourself. If your process includes precision blending, your visit will be worth your while. The Patterson-Kelley Co., Inc., 1511 Hanson St., East Stroudsburg, Pa. (in the heart of Pennsylvania's scenic Pocono Mountains).

Patterson Kelley
Chemical and Process Division

sulfate-bearing refinery electrolyte, and two more are going into a copper refinery in the Southwest.

Sharing credit for this latest advance in a long-neglected unit operation is National Aluminate Corp., Chicago, whose recently developed acid-resistant, semipermeable vinyl membranes (*Chementator*, May 5, p. 45) have more than twice the transfer capacity of parchmentized paper.

High mechanical strength of these membranes makes it possible to build the Graver units with special plastic frames only ¼ in. thick, thus packing up to 300 frames into a normal size filter-press assembly.

Solvent extraction wins more metals

Revealed for the first time in this issue (see Process Flowsheet, pp. 103–106) is Electro Metallurgical Co.'s process for making pure tantalum and columbium (niobium). Key step is separation of the naturally associated elements via solvent (liquid-liquid) extraction.

Solvent extraction has now established a firm beachhead in the winning and processing of metals. AEC and private uranium processors pioneered in this effort, both in winning uranium from ores and in reprocessing of spent nuclear reactor fuels. Next came zirconium-hafnium separation via solvent extraction. Now it's Ta-Cb (and Ni-Co, see p. 47).

Along with Electromet, Wah Chang Corp. has been using solvent extraction in its Ta-Cb operations at Albany, Ore., for the past two years. And Fansteel Metallurgical Corp. is gradually swinging over to solvent extraction, although continuing to operate its fractional crystallization process.

Also favoring extraction is potential Ta-Cb producer National Distillers. Current development work aims at scaling up an extraction process to plant size.

Kawecki Chemical is studying extraction, while turning out commercial products via fractional crystallization. But another producer, Kennametal, uses neither fractional crystallization nor solvent extraction, won't reveal any details of its process.

Lignite gasifier discharges liquid ash

Pressure gasification of lignite with steam and oxygen will be explored in a new pilot plant now being tuned up by the Bureau of Mines at Grand Forks, N. D. Object: Eventual commercial synthesis of ammonia, methanol, liquid fuels and pipeline gas from abundant—but virtually untapped—North Dakota lignite.

Voted as most likely route from lignite to synthesis gas is the Lurgi fixed-bed gasifier. As Bureau engineers point out, more than 40 fixed-bed pressure gas generators have been built by the German company around the world to produce substitutes for coal gas or synthesis gas. These units have gasified a variety of coals—dried brown coal, lignite, weakly caking bituminous coals and noncaking, high-ash bituminous coals.

The new pilot gasifier will differ from conventional Lurgi units in that it will operate under slagging conditions, i.e., ash will form as a liquid. This will permit operation with a lower steam-to-oxygen ratio, thus giving higher over-all thermal efficiency and increased gas-making capacity.

Gas generator has a fuel-bed cross section of 1½ sq. ft. It is divided into four sections so that height of bed can be varied, for different fuels and processing conditions, between 6 and 15 ft.

No. 1 problem will be development of an operable device for tapping slag under 700 psi. Bureau engineers are banking on a lock-hopper arrangement in which the slag is quenched in water, granulated and accumulated for intermittent discharge to atmospheric pressure as a slurry.

New process avoids hazards of HF

A safe, simple route to uranium tetrafluoride, worked out by the Spanish Board of Nuclear Energy, will be promoted by the German firm, Degussa, via a licensing arrangement with the Spanish agency.

Degussa has delivered a uranium plant, incorporating the new fluorination step, to the Argentine and has on hand an order for a similar plant for India.

In the new process, ammonium diuranate is reacted with vaporized ammonium fluoride for 4–5 hr. at 500 C. according to the equation:

$$3U_2O_7(NH_4)_2 + 24NH_4F \rightarrow 6UF_4 + 26NH_3 + 21H_2O + 2N_2$$

In the U. S., UF_4 is made by reacting UO_2 with anhydrous HF. The Spanish chemists hit upon the use of NH_4F as a way to get around the need for corrosive, hazardous and (locally) unavailable HF.

Walkway to efficient dust control

See those bags? They're the *collect* in the Pangborn Cloth Bag Dust Collector. And they're efficient! The cloth filter has proved the most practical method for collecting finely divided dry dusts. But Pangborn goes a step further. Pangborn engineering has not only adapted this design to increase its collecting effectiveness but has simplified its construction. This means you save money. The Pangborn Cloth Bag Collector offers maximum efficiency, yet is economical to buy, install and operate.

Pangborn engineering is important to every dust-producing plant, regardless of the kind of collector needed. It is not enough to put a dust collector within a plant. An efficient dust collecting system must be *scientifically* planned, designed and constructed to handle effectively a specific dust problem. This thinking is incorporated into every Pangborn proposal.

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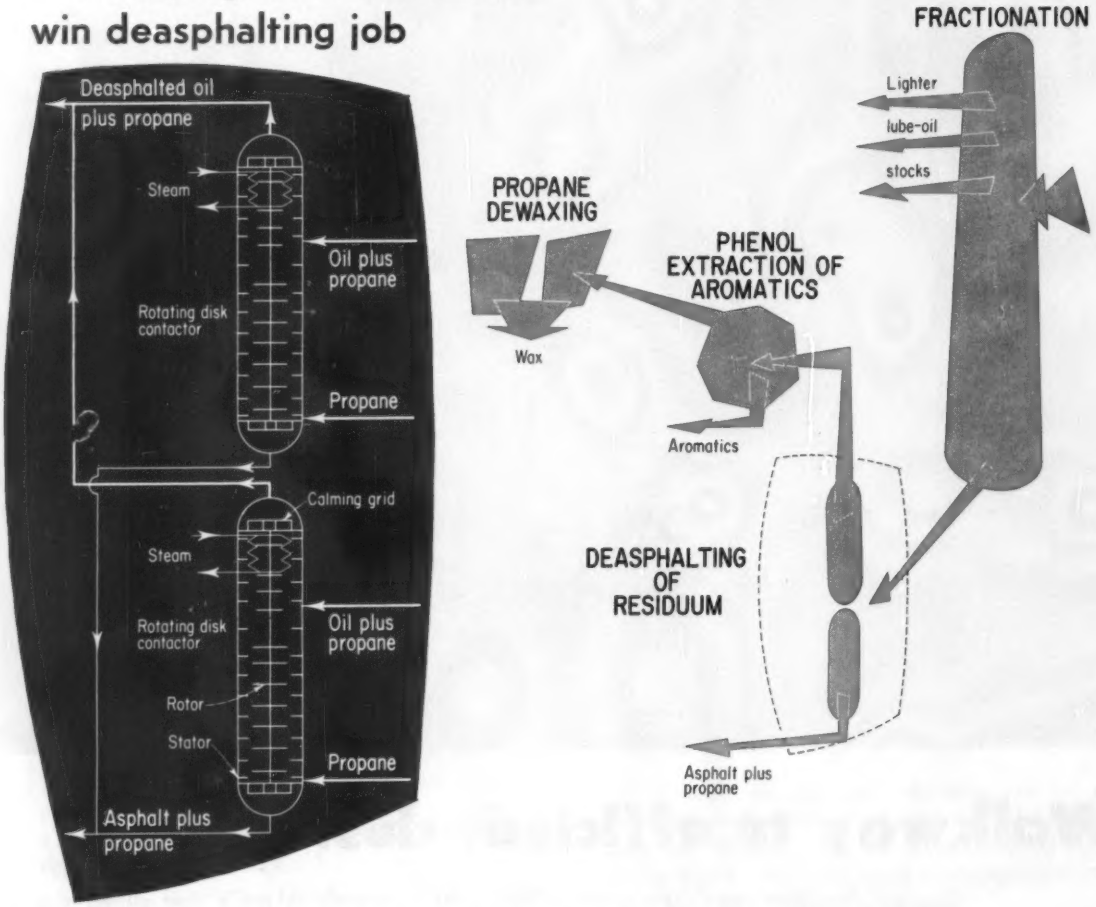
Pangborn CONTROLS DUST

In updating lube-oil refinery operations . . .

. . . rotating-disk contactors win deasphalting job



Better Deasphalting Keys Lube-Oil Setup*

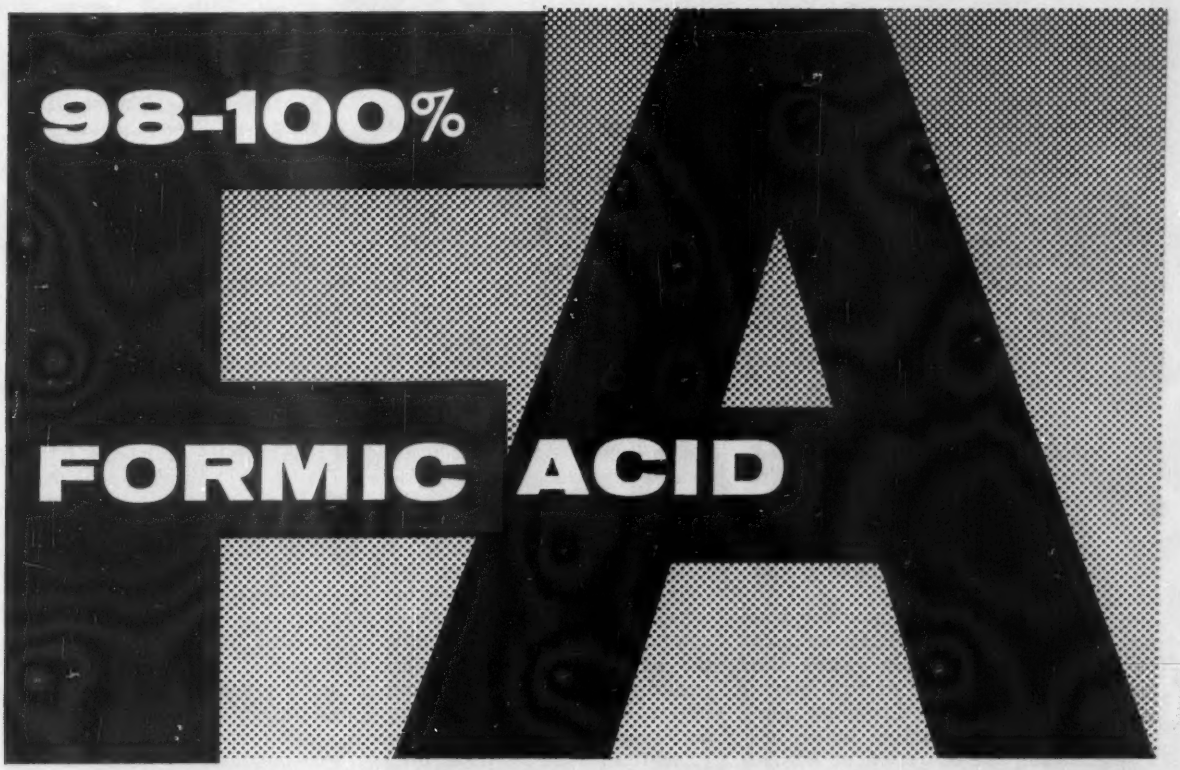
Shell's new deasphalting idea, teamed with tighter fractionation and other process improvements, will boost yield, quality and capacity in its lube-oil refining.

So extensive is Shell Oil Co.'s modernization of lube-oil refining facilities at its Wood River, Ill., refinery, that in many respects the revamped flowsheet looks completely new.

Key units of new equipment number in every major step (except one—propane dewaxing; see p. 143) of the refining route: fractionation, aromatics extraction and—most significantly—propane deasphalting. Vastly improved deasphalting is one big reason that Shell is able to double output with only a 50% increase in charge capacity.

When modernization is complete next May, Wood River facilities will process about 12,500 bbl./day of charge, turning out around 4,000 bbl./day of finished lubes. Revamped setup will produce better-quality lubes at higher yield while scoring attractive economies in capital and

* For modernization of Shell's propane dewaxing, see p. 143, this issue.



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operating costs. Shell figures it saves just about 50% in capital costs by modernizing instead of building new facilities from scratch.

▶**New Contactors Deasphalt**—Most noteworthy feature of the new deasphalting setup is first-time use of Shell-developed rotating-disk contactors (RDCs) at relatively high pressures needed for propane deasphalting of residuum from vacuum fractionation.

Consisting internally of a series of disks (rotors) mounted on a vertical rotating shaft, RDC gives better countercurrent mixing of oil and propane, gets 5-10% more deasphalted oil than previous mixing and settling method.

More important, however, use of RDC deasphalting enables Shell to profitably switch the former sequence of two operations—propane dewaxing and aromatics extraction. Before detailing the operation of RDC's, it's interesting to look over other major new equipment items and to see how deasphalting figures in other benefits.

▶**Other New Equipment**—Here are the other major equipment improvements:

• *Fractionation.* For vacuum fractionation of charge into some 10 different lube stocks, Shell is replacing old shower-deck fractionator with a tower using Flexitrays. New tower, explains Shell, will give sharper fractionation and tighter process control in later operations.

• *Aromatics extraction.* For removal of sludge-forming aromatics, Shell previously used Duo-Sol solvent extraction. Duo-Sol, because of inefficient deasphalting step, needed fairly large amounts of propane to extract asphaltic paraffins.

In the new setup, Shell will use phenol-extraction method with two 5-ft.-dia. by 4-ft. Podbielniak centrifugal extractors. Compact centrifugals, Shell points out, have a hold-up of only about 5 bbl. each but do the same job as an 11-ft.-dia., 110-ft.-high tower with hold-up of about 500 bbl. Thus, there's a sharp reduction in the amount of "off-spec" or cross-over lubes that result when a new stock begins processing.

▶**Here's the Switch**—In the revamped setup, Shell gains several pluses by extracting aromatics before propane dewaxing. (However, Shell stresses the point that the switch wouldn't have made good sense without improved RDC deasphalting.)

Previously, in the extraction step, Shell had to use propane on the poorly deasphalted residuum stock and therefore on all stocks. In other words some nine stocks were getting propane when they didn't need it. And it's an expensive luxury to pump around unneeded propane. In the new setup, only residuum is treated with propane—and then only in the deasphalting step.

Moreover, Shell had been letting a sizable slug of dewaxing capacity go unused. This "non-dewaxing" capacity was equal to the amount of aromatics that passed through dewaxing step before being removed in aromatics extraction. By removing aromatics before dewaxing, Shell is able to make better wax, too.

Of course, as Shell points out, deasphalting now needs its own propane-recovery system. Before, dewaxing recovery system took care of propane from deasphalting, too. But advantages of the revamped process far outweigh expense for new recovery system.

▶**RDC Operation**—Shell operates two 8-ft.-dia. 40-ft.-high RDCs in parallel, feeds half the charge of propane and oil (in about a seven-to-one ratio) to each. Propane-oil ratio depends on the particular stock being processed. Oil, mixed with a small amount of propane, enters the top part of the RDC and propane is fed in the bottom. RDCs operate at about 475 psig. and 170 F. maximum.

Inside, liquid contacting is aided by rotation of 20 disks on the central shaft and by baffling effect of 23 stator rings attached to the inside of the contactor. Rotor shaft, motor-driven at the bottom, turns at 10-50 rpm.

Calming grids (open egg-crate construction) help keep liquid quiet in top and bottom settling compartments.

▶**Reflux Effect**—Of critical importance in RDC operation is maintaining the right temperature gradient in upper part of the tower.

As oil-propane solution rises in the tower, Shell explains, propane rises in temperature and dissolves less oil—the heavier oils come out of solution and act as reflux in the tower, thus controlling a sharp separation.

Shell uses steam coils heated with 150-lb. steam to maintain temperature gradient of, typically, 130 F. at the oil inlet to 170 F. at the top outlet. Temperature recorder-controllers on the top oil-effluent stream control feed rate of steam.

▶**Bright-Stock Run**—Let's take a look at typical deasphalting procedure on a run to produce one of the major lubes (Ellenburger bright stock, 150 Saybolt seconds at 210 F.) from a short residuum of about 0.94 specific gravity. Charge is about 2,700 bbl./day (37,100 lb./hr.) for 2,040 bbl./day of deasphalted oil and 660 bbl./day of asphalt. Total propane is 200,000 lb/hr.

Residuum is run countercurrent to hot, stripped asphalt product, then cooled from about 236 F. to 130 F. and mixed with around 20,000 lb./hr. of propane. Mixture splits, half of it entering each RDC, and is contacted with the remaining 180,000 lb./hr. of propane.

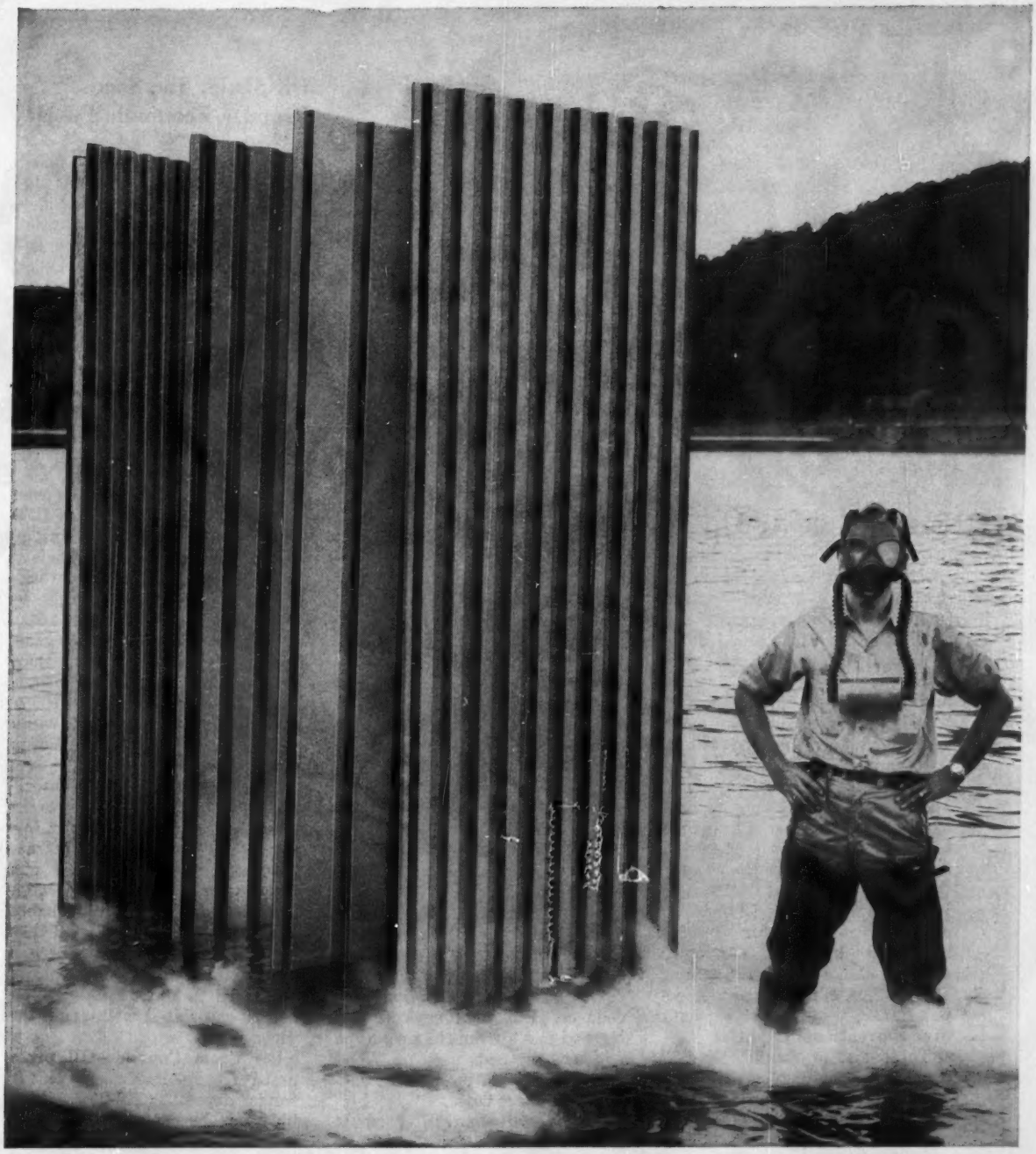
Propane and deasphalted oil leave the top of the RDCs at about 170 F. Asphalt and propane leave the bottom at about 110 F.

Co-60 Opens New Route To Low-Cost Detergents

Radiation from cobalt-60 can trigger a reaction called "sulfoxidation" to produce potentially low-cost paraffin-based detergents.

Esso researchers at Linden, N. J., report that gamma rays from Co-60 will cause the reaction of sulfur dioxides and oxygen with liquid paraffins. Once the reaction starts, the Co-60 can be removed and returned to its storage cell.

Sulfoxidation of paraffin oils may offer economic advantages over other routes to synthetic detergents (e.g., sulfonation of aryl alkylates, sulfation of fatty alcohols) by virtue of lower-cost raw materials and elimination of undesired byproducts.



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Dome Speeds Up Materials Handling

Looking like a prop from a science fiction movie, Union Tank Car Co.'s brightly painted dome at Baton Rouge, La., is that firm's answer to the constant problem of maximizing usable building space at minimum cost.

Dome, 384 ft. dia. and 120 ft. high, covers a complete tank car repair facility (tunnel at left in photo houses painting operations). Union Tank is first firm to erect such a large geodesic structure and is more than happy with results to date: Circular interior, free from columns or supports, is ideal for efficient materials handling. Circular transfer table at dome's center shunts tank cars into proper repair stalls, tripling car capacity over conventional facilities.

Total cost of facility was $3 million; dome itself cost around $1 million. "This dome cost of less than $10/sq. ft. for 110,000 sq. ft. of useable space is a considerable saving over a conventional structure," says a Union Tank spokesman.

As evidence of its faith in dome construction, Union Tank is erecting an identical repair dome in Wood River, Ill., and is establishing a dome division with its subsidiary, Graver Tank & Mfg. Co., to build domes for other companies.

▶ **Aluminum Version** — Kaiser Aluminum has been building smaller domes (maximum 200 ft. dia.) out of aluminum. Only industrial aluminum dome to date is a 145-ft.-dia. unit in Abilene, Kan., housing a conveyor manufacturing plant.

Although aluminum is rust-resistant, Union Tank picked sheet steel for its dome because steel is cheaper and firm is experienced in steel welding. Union Tank engineers say they aren't worried about corrosion or frequent maintenance: Dome is painted with same coating system that has lasted for 20 yr. on tank cars.

Another attraction that dome boosters cite is speed of erection. Union Tank's first dome took several months to put up because of radically new construction procedures. But firm says it has learned much from the prototype and new methods used on Wood River dome will speed construction and lower costs.

Basic mathematical formula for the geodesic dome principle was developed in the 1930's by R. Buckminster Fuller who was chief consultant on Union Tank's dome. Dome consists of an inner tension shell of hexagonal panels attached to an outer compression shell of steel pipes bolted in hexagon patterns. Any stress on the dome's skin is dissipated over dome's entire surface. Evidence of the dome's tremendous strength-to-weight ratio is the fact that it withstood hurricane-force winds even before the top panels were welded in place.

Oil Shale, Tar Sands Promise Economic Fuels

Two vast sources of fossil fuels—Colorado's oil shale deposits and Alberta's tar sands—are shaping up as potential sources of economic energy, according to two recent reports.

Experiments at Institute of Gas Technology, Chicago, Ill., indicate that newly developed process can turn out an 800-Btu./cu.-ft. fuel gas from oil shale for an attractive 30¢ per 1,000 cu. ft. Process involves one-step hydrogenation of crushed shale at high temperatures and pressures.

Shale-gasification process was outlined by E. B. Schultz of IGT at the recent national meeting of the American Chemical Society in Chicago. (IGT is also working on coal gasification; see *Chem. Eng.*, Oct. 1957, p. 164.)

Schultz claims that shale gasification is more efficient than current oil-from-shale procedures: Gasification nets 90-100% of shale's organic content, while shale-oil processes recover around 80%.

Although natural gas associated with crude oil reserves in this country is adequate for immediate future, economic attractiveness of recovering this gas (especially in light of foreign crude imports) will probably diminish. Schultz estimated that 6,000 trillion cu. ft. pipeline gas can be wrung from shale deposits compared to about 1,200 trillion cu. ft. associated with crude reserves.

▶ **Oil From Canada**—Oil processed from Alberta's huge tar sands deposit (100-200 billion bbl.) can be profitably delivered to Great Lakes region, said D. S. Pasternack of Research Council of Alberta at A.I.Ch.E. meeting in Salt Lake City.

Pasternack cited the S. M. Blair study compiled for the Government of Alberta that pegged cost of mining, processing and transportation at $3.50/bbl., making tar-sands crude competitive with other crudes. Based on capital investment of about $44 million, a plant producing 6 million bbl./yr. would yield around 5.5% return on investment.

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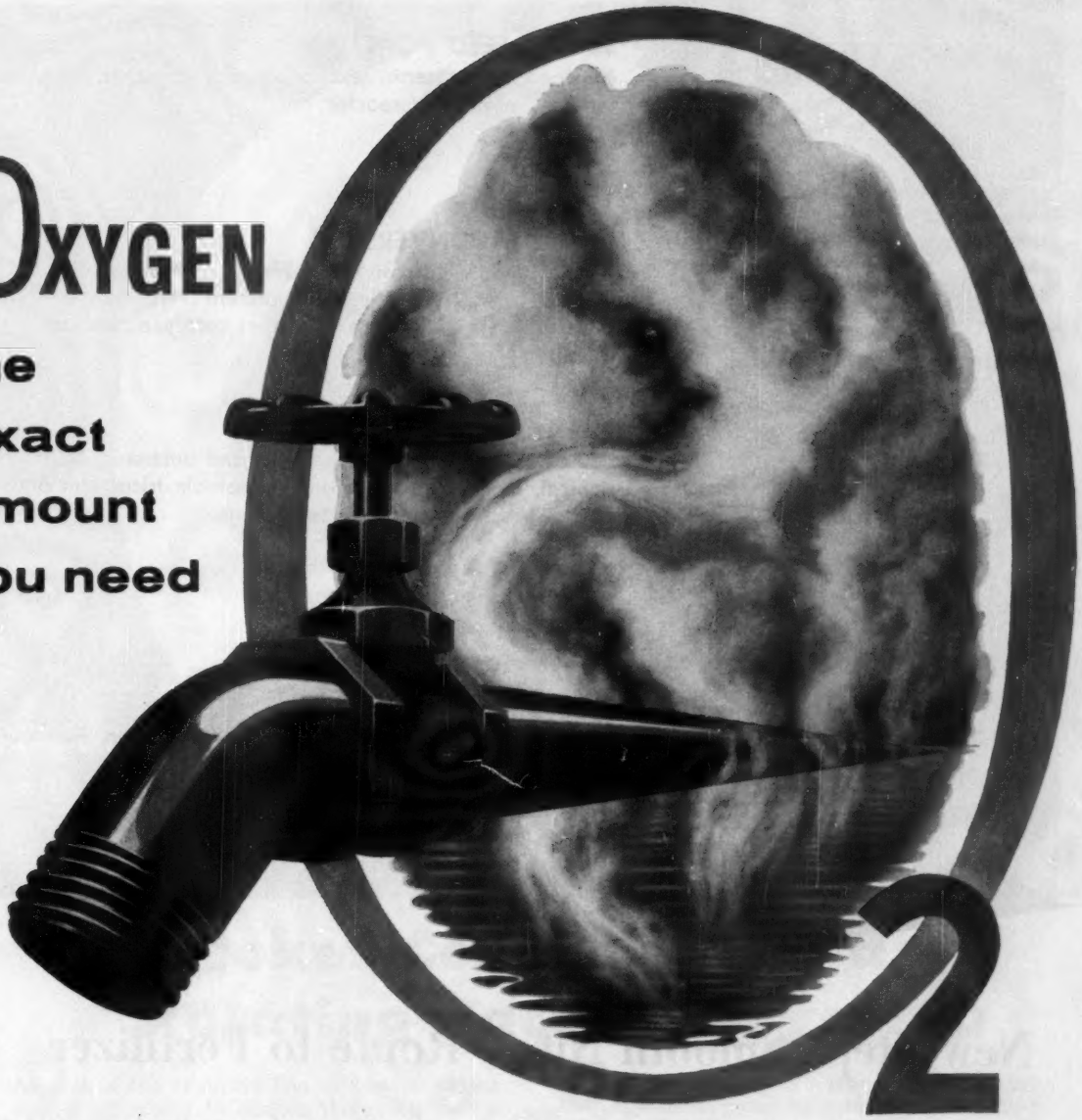

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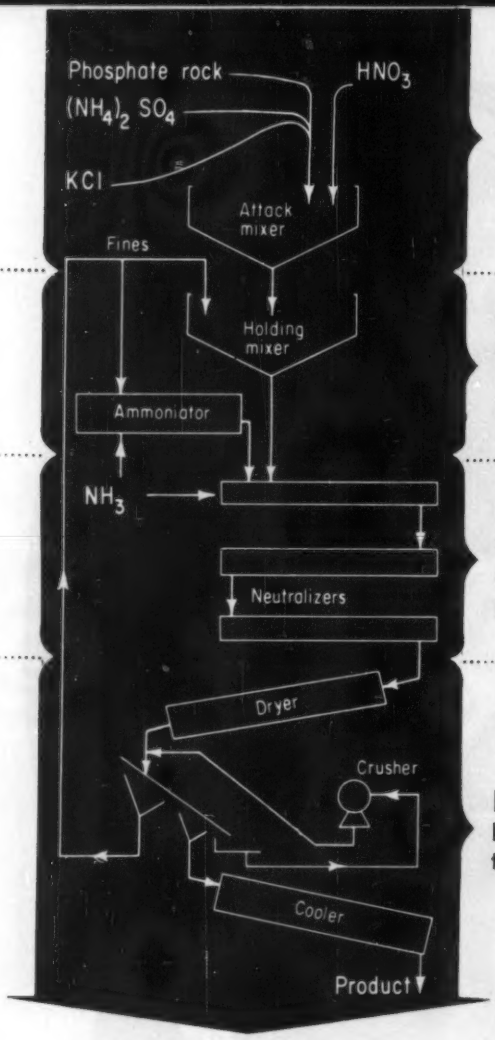


SINGLE FEED POINT
All feed components, except ammonia, enter complex fertilizer process at reactor.

NITRATE CONVERSION
Hygroscopic, corrosive, primary reaction product $Ca(NO_3)_2$ reacts with feed component $(NH_4)_2SO_4$ to form desirable NH_4NO_3. Recycling fines catalyze reaction.

NEUTRALIZATION
Use of ammoniated recycled fines and ammonia simplifies control, avoids retrogression to insoluble tricalcium phosphate, uses fewer neutralizer vessels.

HOT FINISHING
Direct-fired drying makes stronger final particles than low-temperature granulator.

New Steps Smooth Nitric Route to Fertilizer

- **Refinements simplify process, lower cost**
- **Versatility permits wide range of formulations**
- **Strong product particle reduces dust problems**

Less costly acidulation of phosphate rock with nitric acid to make complex fertilizers now is being introduced to the United States by Vitro Engineering Co., New York.

Process offers unique answers to some of nitric's previous shortcomings, and thereby, reduces the capital investment for equipment. In the U. S., Vitro expects cost for a 220 ton/day plant to be about $600,000, not including the building.

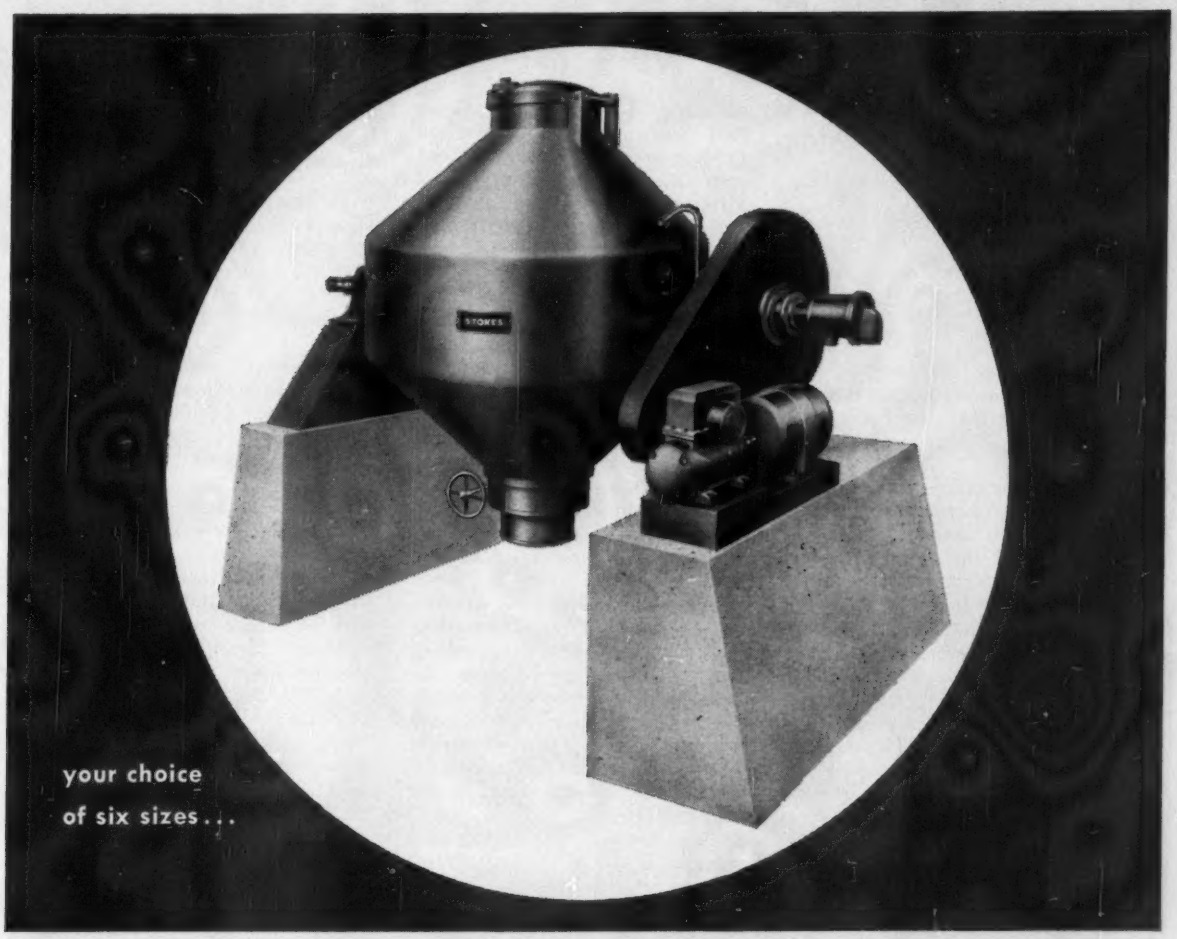
Developed by Societe de Produits et Engrais D'Auby, Paris, process first went commercial in Europe in 1945. It now operates successfully in four European plants ranging from 200 to 500 tons/day output.

▶ **Key Auby Gains**—Auby's cost savings start with the rock feed. With nitric acidulation, reaction proceeds without slowdown because there is no formation of pore-plugging $CaSO_4$. Therefore, there is no need to grind rock into small particles prior to acidulation.

Strangely enough, formation of $CaSO_4$ is an important secondary reaction to eliminate corrosive, hygroscopic calcium nitrate as soon as it forms. Other nitric acidulation processes require more complicated measures to remove calcium nitrate later in the process.

Auby relies on ammoniated, recycled fine product to neutralize the material discharging from the acid attack step. With this technique, process achieves desired result without danger of reversion of P_2O_5 to insoluble tricalcium phosphate, usually associated with direct ammoniation.

▶ **Highly Flexible** — Excellent process control during both attack and neutralization steps permits Auby to produce many different formulations to meet



Stokes Conical-Shaped Rotating Vacuum Dryers

As part of the extensive line of vacuum drying equipment offered by Stokes, this rotating cone dryer is available in six sizes. Built to Stokes' high vacuum standards, they are especially suited for those materials which require the tumbling action and/or the charging and discharging features offered by this type of dryer.

Stokes conical-shaped dryers are double-walled, and include provisions for steam or hot water heating. The interior surfaces can be supplied in carbon steel or in 304 or 316 stainless steel for use with corrosive products. The large, full-opening charging inlet is provided with a quick-acting hinged cover. The discharge port features a self-wiping vacuum-tight valve, worm-gear actuated. Every drum is vacuum tested by mass spectrometer.

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Approx. Wt.	1,750	2,400	3,200	7,700	11,500	12,700

**In cubic feet—normal working capacity is 65% of total volume*

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any specific agricultural needs. This includes formulas of unusually high analysis. Within a single plant, operation can shift from one formula to another within a few hours.

Final product particles are said to be much stronger than those produced in a conventional low-temperature granulator, thanks to use of a direct-fired dryer for finishing. This reduces dust recycled in the process to a minute fraction of that prevailing in other processes. Free from dusting, product does not set up in storage, does not break down in shipping or application.

▶**Single Feed Point**—All raw materials feed into the same acid attack vessel during the first process step. Phosphate rock and salts such as KCl and $(NH_4)_2SO_4$ feed out of storage hoppers onto a conveyor which discharges into attack mixer. Required amount of acid is metered into tank by pump. Sequence of addition, pH and temperature are controlled to produce desired reaction conditions.

After about 7 min., soupy mixture flows into holding mixer for 60-90-min. retention while reactions go to completion. About half the fines recycled from product end of process also feed into this tank to maintain desired consistency and catalyze reaction between $Ca(NO_3)_2$ and $(NH_4)_2SO_4$ to form $CaSO_4$.

▶**Neutralization** — The other portion of recycling fines goes to a specially designed Holoflite conveyor for ammoniation. Fines absorb ammonia equivalent to about 2½% of their weight. Agitation and cooling from water passing through conveyor flight prevents dicalcium phosphate retrogression.

After ammoniation, these fines together with an equivalent amount of ammonia enter the first neutralizer to contact paste conveyed over from the holding mixer tank. While undergoing neutralization, the mass moves through three neutralizers, altogether. In the second neutralizer, cooling begins due to evaporation of water formed during the exothermic neutralization reaction and water present in the raw materials.

Granulation and drying are completed in a rotary dryer. Screening removes oversize for grinding and recycle back over screen; fines recycle back into process.

After final cooling, fertilizer is ready for packaging. Addition of small amounts of kieselguhr at this point enhances storage characteristics.

▶**Who Else Uses Nitric**—Here, in the U. S., other nitric acidulation processes already have made a few inroads against entrenched use of sulfuric acid to free P_2O_5 tied up in phosphate rock.

For years, TVA has worked on perfecting nitric acidulation processes. At South Point, Ohio, and Sheffield, Ala., Allied Chemical and Associated Co-operatives, respectively, use nitric-phosphoric and nitric-sulfuric for attack. Calspray in Richond, Calif. has perhaps the only commercial U.S. plant operating on straight nitric (*Chem. Eng.*, Oct. 1956, p. 358).

▶**Auby vs. Others**—Differences between Auby and these other processes relate mainly to how Auby grapples with problems common to all.

Auby removes calcium nitrate from the fertilizer right at the attack stage by quantitative additions of potassium or ammonium sulfate to convert calcium nitrate to calcium sulfate. By contrast, other processes remove calcium nitrate physically via crystallization and centrifuging.

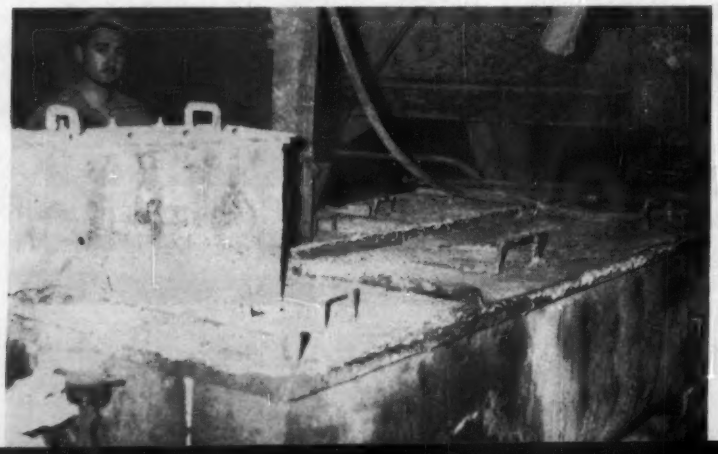
Or CO_2 can be used to convert the nitrate to carbonate. But then, conversion must be incorporated with neutralization in order to have the required neutral medium. Conversion at this point increases the danger of reversion of soluble P_2O_5 to insoluble, useless tricalcium phosphate. To avoid such reversion, metallic salt must be added before neutralization.

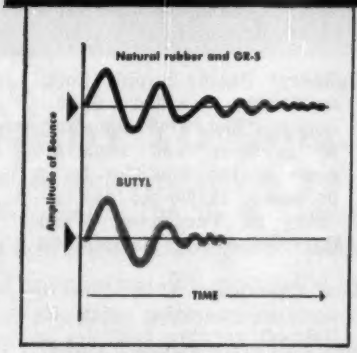
Or use of a sulfuric-nitric acid mixture for attack takes care of excess calcium nitrate. However, this approach forms large amounts of nitric fumes which reduces nitrogen recovery. Auby has no such problem with nitrogen yield as high as 98%.

▶**Solid Neutralizer** — Auby's novel use of solid neutralizer, in the form of ammoniated fines, eliminates five of the eight neutralization vessels used for conventional neutralization by liquid or gaseous ammonia. In Europe, Auby actually uses phosphorus-laden basic slag neutralizer.

Ideally, direct ammoniation should be the simplest way to neutralize the acidulated rock. Actually, direct ammoniation requires great care lest excess ammonia push the reaction too fast, raising temperature sufficiently to push P_2O_5 back to its insoluble tricalcium state. That's why other processes use as many as eight vessels to which ammonia may be added gradually in small amounts.

SOLID neutralizing agent mingles with fertilizer in this trough mixer.





Butyl's superior shock absorption characteristics reduce amplitude of bounce in much less time as compared with other rubbers.

Enjay Butyl, because of its higher damping factor, absorbs shock energy *more* completely than any other rubber. Through simple variations in compounding or processing, you can build the right degree of resiliency for your requirements. Butyl is the ideal rubber for motor mounts, load cushions, sound deadener insulation, axle and body bumpers—and other shock, noise and mechanical vibration applications.

Butyl *also* offers outstanding resistance to weathering and sunlight . . . chemicals . . . heat . . . abrasion, tear and flexing . . . unmatched electrical properties and impermeability to gases and moisture.

Find out how this versatile rubber can improve your product. Call or write the Enjay Company, today!

ENJAY®
BUTYL

ENJAY *Pioneer in Petrochemicals*

ENJAY COMPANY, INC., 15 West 51st Street, New York 19, N. Y.
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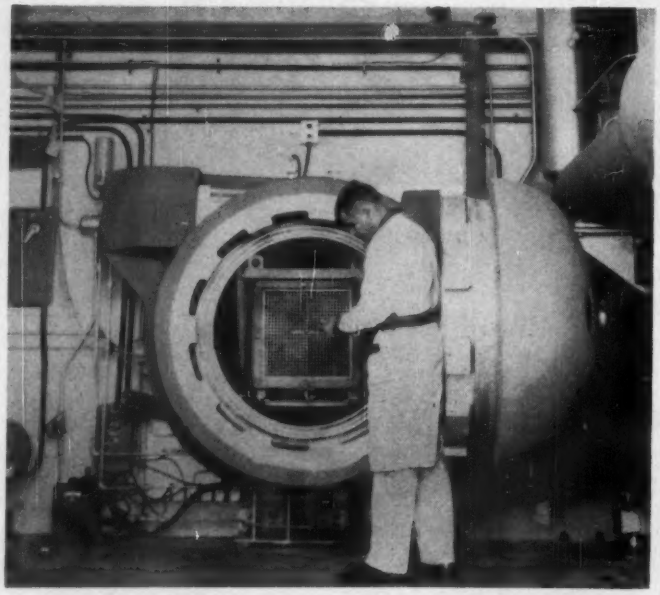


New Facility Helps Predict Reactor-Core Behavior

New unit, dubbed the "hot exponential facility," will help engineers determine how reactor cores will behave at operating temperatures. In the past, according to Babcock & Wilcox who designed and engineered the unit, operating behavior of the core was determined by calculations based on room-temperature experiments. Unit, above, consists of a 3-ft.-dia., 9-ft-long pressure vessel spanned by a reactor as a neutron source.

Electric Smelting Step Wins High-Purity Iron

U. S. Bureau of Mines' investigations at Albany, Ore., indicate that it's feasible to produce high-purity iron directly from high-grade concentrates via one-step electric smelting.

BuMines feels the technique could be useful in producing steel ingots for small rolling mills in remote areas where it's impractical to install blast furnaces, converters or open-hearth furnaces.

Here's how the technique works: Magnetic concentrates are mixed with lime, Montana coal and wood chips and then smelted via dry-top, selective reduction in a pit-type, three-phase electric smelting furnace. Experimental furnace has 45-in. inside dia., and is lined with magnesite. Power input is 300 kw.

In a 58-hr. continuous test, 93% of the iron charged to the furnace was recovered as iron analyzing 99.6% Fe.

Catalyst Streamlines Silicone Polymerization

New "transient" catalyst developed by General Electric Co. brings into view for the first time the possibility of making silicone gums and oils via continuous polymerization.

Catalyst is tetra-n-butyl phosphonium hydroxide—a material that can be decomposed at moderate temperatures. In continuous polymerization, low molecular weight siloxanes and catalyst are pumped to heated reactor. After polymerization, reaction mixture flows continuously to second reactor where catalyst is thermally destroyed at slightly higher temperature than first reactor. Decomposition products are inert and concentration is only a few hundredths of a percent so they don't have to be separated from the polymer.

Silicone industry now uses batch processing for gums and oils and polymerization catalyst has to be removed or neutralized after reaction. Norman Kirk, describing development at recent American Chemical Society meeting, emphasized, however, that continuous process was still on laboratory scale and hasn't been evaluated commercially.

NEWS BRIEFS

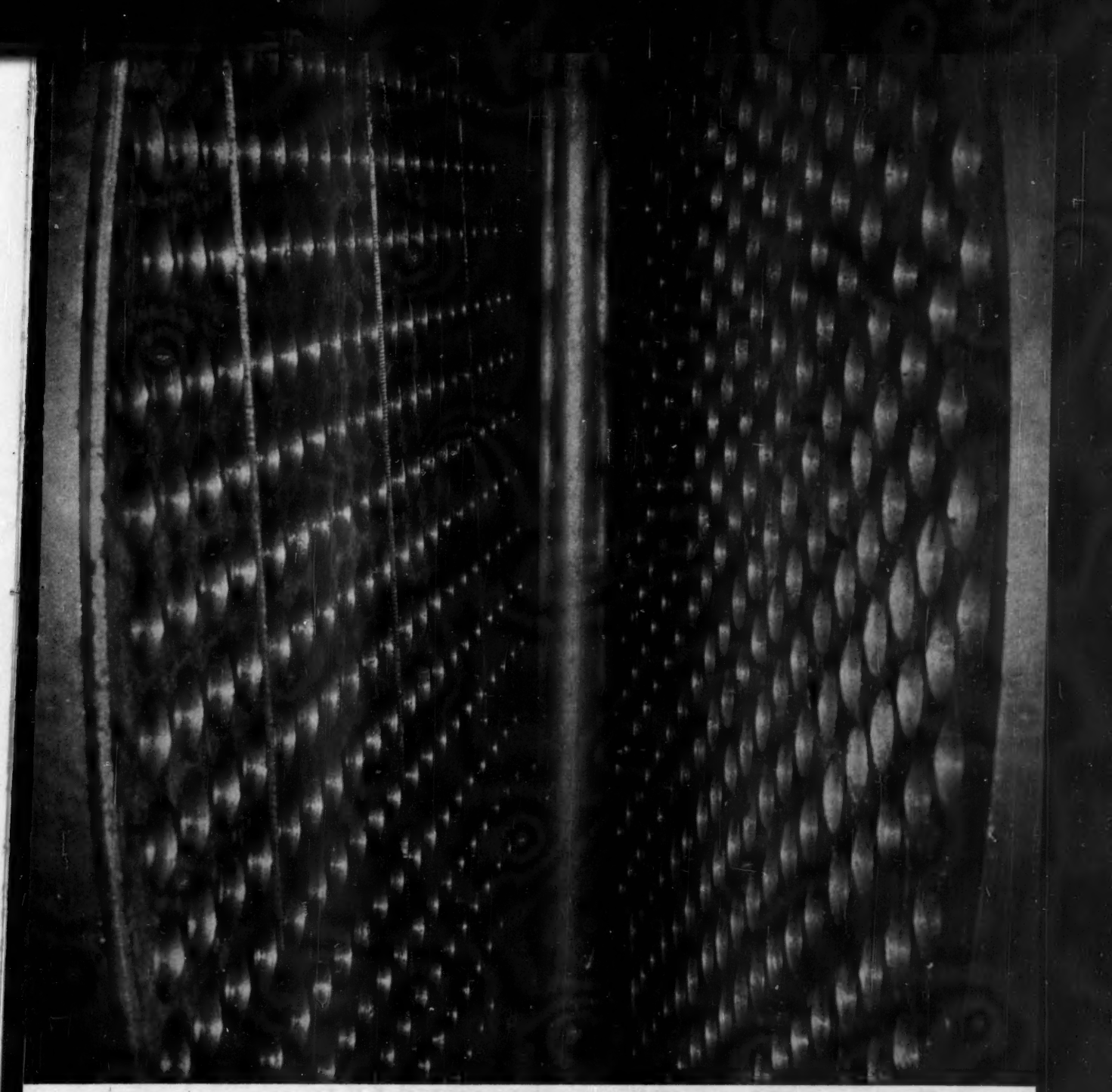
Liquid feed: U. S. Industrial Chemicals has completed its new liquid feed premix plant at Anaheim, Calif., is now producing premix concentrate for liquid livestock feed, tradenamed Morea (*Chem. Eng.*, Mar. 10, 1958, p. 69).

Sulfur: Anlin Co. of Illinois is building a 150-ton/day sulfur-recovery plant next to Shell Oil Co.'s Wood River, Ill., refinery. On-stream date is set for the middle of next year.

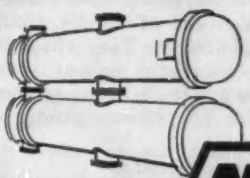
Epoxidized oil: General Mills has now started production of epoxidized soybean oil at new facilities in Minneapolis, Minn. General Mills hints that it's using its own process to epoxidize unsaturated vegetable oils and fatty esters.

Refinery: Pacific Supply Cooperative has awarded a $2-million contract to Fluor Corp. to engineer and construct some of the facilities for a proposed 15,000-bbl./day refinery at Vancouver, Wash. Completion date: March, 1959.

Coal Chemicals: U. S. Steel is now in operation with its light-oil refining facilities at Clairton, Pa. Setup is processing 150,000 gal./day of crude coke-oven light oil.



READY TO ROLL from storage racks to bundling jigs, these heat exchanger tube sheets symbolize the assembly-line techniques developed by The M. W. Kellogg Company to speed fabrication, yet still adhere throughout to the highest standards of design and engineering. To assure the optimum in heat transfer equipment for petroleum refinery and chemical plant service, call Kellogg's Fabricated Products Sales Division.



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M KELLOGG W

DEVELOPMENTS . . .

CHEMICAL ECONOMICS

EDITED BY D. R. CANNON

World Oil Market: Bigger Share for Middle Distillates and Fuel Oil

North America[1]

Percent of Market[2]

Oil Market	1956 Gasoline	1956 Middle Distillates	1956 Fuel Oil	1966 Gasoline	1966 Middle Distillates	1966 Fuel Oil
Air	100	—	—	80	20	—
Road	100	—	—	90	10	—
Rail	—	88	12	—	95	5
Inland, coastal shipping	—	12	88	—	19	81
Ocean shipping	—	12	88	—	15	85
Heating & lighting	—	82	18	—	80	20
Gas & electricity	—	6	94	—	3	97
Industry	—	19	81	—	5	95
Agriculture	96	4	—	67	33	—
Misc.	20	72	8	23	65	12
Total Oil Market	45	30	25	40	34	26

More kerosene-type fuels for jets, turbo props

More diesel power for heavy transport

Eastern Hemisphere[3]

Percent of Market[2]

Oil Market	1956 Gasoline	1956 Middle Distillates	1956 Fuel Oil	1966 Gasoline	1966 Middle Distillates	1966 Fuel Oil
Air	80	20	—	50	50	—
Road	73	27	—	67	33	—
Rail	—	22	78	—	80	20
Inland, coastal shipping	—	49	51	—	62	38
Ocean shipping	—	24	76	—	15	85
Heating & lighting	—	100	—	—	89	11
Gas & electricity	—	43	57	10	20	70
Industry	—	18	82	—	20	80
Agriculture	16	77	7	10	90	—
Misc.	37	37	26	37	37	26
Total Oil Market	23	32	45	17	36	47

More kerosene-type fuel for jets, turbo props

More dieselization programs ahead

Bigger ships on way need steam power

Refiners Must Change Their Yield Patterns

Today's gasoline inventories are elephantine. What's worse, they are unrealistic when viewed against stocks of middle distillates and fuel oils. They will grow more unrealistic unless some changes are made in the pattern of yields of refinery products.

A shifting demand for oil products — already trending away from gasoline—will force, in the next ten years, a soul-searching, and a belt-tightening, on the part of refiners. Otherwise oil's entire price structure is in jeopardy.

How serious the imbalance could become is plainly seen in the observations and forecasts made by British Petroleum's M. E. Hubbard at the World Power Conference in Montreal early this fall.

▶ **"Mobile" Share Is Less**—Hubbard notes that the proportion of total fuel used for small mobile units (air and road transport, and agricultural machinery) is falling in both the East and West. In other words, demand

[1] U. S. and Canada.
[2] Excluding natural gas.
[3] Except USSR, Eastern Europe and China.

RECIRCULATION MAY BE KEY TO FUTURE GROWTH OF CHEMICAL AND INDUSTRIAL PROCESSES

• AN ADAMS REPORT

Number 2 of a Series

How much water do you need to make: a ton of steel? a ton of synthetic rubber? a ton of bromine? a barrel of beer?

These are not empty questions. They point to a critical problem which confronts management today in its plans for tomorrow. It is more crtical than most of us realize . . . for industry today uses as much water as all other users.

Industry's Needs in 1975

Water is vital for chemical and industrial growth. By 1975, industry will require 215 billions of gallons daily. That is a 100% increase over our current industrial consumption . . . more than we currently consume for all uses combined.

Competing for this water will be irrigation farmers and the general public. Their combined needs by 1975 will be up 40 billion gallons a day . . . possibly even more.

What is the Supply Picture

More than 40% of the communities in the United States already have a critical water supply problem. Yet, to meet the 1975 needs, our supply must be expanded by 50%, at an estimated cost of $50 billion.

Indications are that industry is going to have to bear its part of this cost. Certain communities are already moving to place flat water rates on all users . . . regardless of the volume used. Other groups are demanding a national water policy with full Federal Government regulation of natural sources.

Chemical Industry's Stake

Shortage of water can be a most serious threat to the expansion hopes of the chemical industry. A glance at the following table shows why. You need approximately:

20,800 tons of water per ton of	Bromine
2,500 " " " " " "	Synthetic rubber
830 " " " " " "	Viscose rayon
300 " " " " " "	Newsprint
208 " " " " " "	Smokeless powder
15 " " " " " "	Coke from coal

While process refinements may be able to reduce slightly the amount of water needed for each product, the gains will be minor.

Difference Between Use and Consumption

This is best illustrated by the water needed to make a ton of steel. The industrial average is 65,000 gallons (271 tons). In the past, 65,000 gallons of water flowed out of a river through the steel mill and back into the river again for each ton of steel made. In this case, use and consumption are one and the same thing.

On the west coast, a large steel mill now requires only 1,100 gallons of makeup for each ton of steel produced. This steel mill has its own recirculation system which holds several million gallons of water. This water is recirculated at a rate equal to 65,000 gallons per ton of steel produced. The only water consumed is that lost due to evaporation or through leakage. Thus, net consumption has been reduced to 1,100 gallons.

Two Bulletins Available

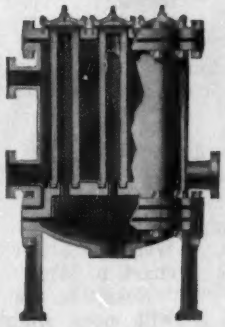
One of the most important pieces of equipment in a recirculation system is a filter. Where high quality process water is needed, diatomite filters will provide an effluent second only to distilled water. Bulletin 651, released by the R. P. Adams Company, Inc., 507 E. Park Drive, Buffalo 17, N. Y., covers this type of industrial water filter.

A second publication, Bulletin 909, covers an Automatic Water Filter which is frequently used in recirculation systems where the water is used for less critical applications. This bulletin is also available on request from the R. P. Adams Company at the above address.

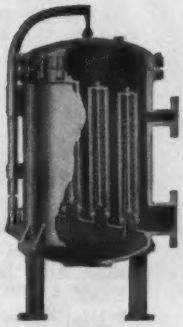
By the way, it takes almost two tons of water to brew a barrel of beer.

NEED A FILTER? FOR CORROSIVE LIQUIDS •

Adams CFR are rubber lined filters which meet corrosion problems which require this type construction. Where lead lining is a must, the Adams CFL filter will meet your needs. Each tubular element of either filter may be removed individually for inspection, or replacement.



Adams CVF Filters are available in carbon steel, stainless steel, Monel and Nickel construction. Also constructed with submerged head for personnel safety and with outer jacket for use with steam or refrigerated coolant to maintain desired temperature.



▶ All Adams Filters provide safe cleaning without disassembly by a sudden, high velocity reverse flow of backwash liquid.

Do you have a filtration problem where corrosive liquids must be given a high polish? Where there is danger to personnel? Where there is a problem of temperature control?

The R. P. Adams Company has a line of filters which will solve any one of these problems . . . or a combination of all.

We may not have the answer to *your specific* problem, but the chances are we do. For the fastest action, we suggest you use the coupon below, or write for Bulletin 431 on your company letterhead.

R. P. ADAMS COMPANY, INC. 207 E. PARK DRIVE BUFFALO 17, NEW YORK

R. P. ADAMS COMPANY, INC. N-58
207 E. PARK DRIVE — BUFFALO, 17, NEW YORK

We have a problem involving the filtration of corrosive liquids. Please send us your Bulletin 431. Also, ask your local representative to call on us.

Name_____ Title_____

Company_____

Street_____

City_____ State_____

from heavy transport (rail and water) and static uses (industrial, heating, etc.) are growing at a faster rate.

Small mobile units traditionally use gasoline. Heavy transport and static uses traditionally employ black oils and/or piped gas.

▶ **Smaller Price Spread**—Hubbard expects this trend to continue strongly, with these possible consequences:

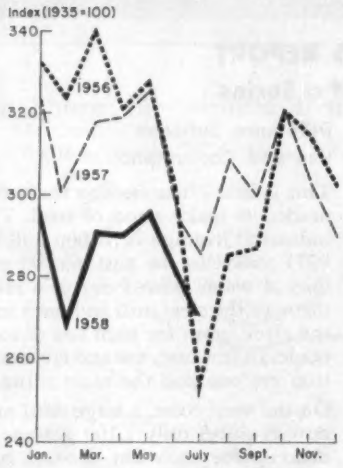
- A further narrowing of the price range between gasoline and fuel oil.
- Increased crosshaul of petroleum products across the Atlantic. More crude oil and, possibly, gasoline will have to move westwards. More middle distillates and fuel oils will have to move eastwards.
- Modified refining methods for both East and West. Main producing areas outside North America and the Eastern Hemisphere, notably the Caribbean, do not have infinite refinery flexibility. Thus, if more fuel oil is to go to the East from these areas, North America can't count on continuing to import disproportionate amounts of fuel oil. It will have to supply more of its own needs by raising fuel oil yields from its own refineries. And the increased demand for middle distillates at the expense of gasoline will call on the East and West for different refining techniques for certain crude oils, especially those from the Middle East.

▶ **Distillates Push Hard**—Gasoline's share of total oil-product demand in the West (excluding natural gas) will slide from 45% to 40% between 1956 and 1966—a tremendous shift in terms of tonnage. Middle distillates (up 4%) and fuel oil (up 1%) will take up the slack. Eastern gasoline demand will drop from 23% to 17% of total fuel-product demand, with middle distillates increasing its share 4%, fuel oils, 2%.

▶ **It All Adds Up**—Let's look at Hubbard's end-use breakdown to see what's behind the big shift for 1956-66.

Aircraft—Wider use of kerosene-type fuels for jet and turboprop aircraft will push middle distillate content of all air transport fuel by 1966 to 20% for the

Chemical Consumption



Consumption by Industries

	June (Final)	July (Est.)
Coal products	7.4	7.2
Explosives	9.7	8.8
Fertilizer	57.6	53.4
Glass	29.3	29.3
Iron & steel	13.1	11.8
Leather	4.0	4.2
Paint & varnish	37.1	35.0
Petroleum refining	29.4	30.5
Plastics	22.3	20.5
Pulp & paper	35.1	33.1
Rayon	20.7	23.2
Rubber	6.0	5.5
Textiles	8.4	7.7
Total	**280**	**270**

West, 50% for the East (see chart, p. 66).

Road—In the West road fuel will move slightly toward the diesel (middle distillates) type—to about 10% of overall road fuel. Diesel oil will claim one-third of all road fuel used in the East by 1966.

Rail—Change from steam to diesel traction is nearing completion in the West. But big dieselization programs planned for the East will push middle distillates' share of rail fuel consumption from 20% to 80% by 1966.

Agriculture — Mechanization of farming is virtually complete for the West. Little new land is likely to be cultivated. Solid growth for diesel-oil consumption is possible in the East, though, where far bigger opportunities for mechanization still exist.

Shipping — Inland waterway transport is moving toward complete dieselization in both areas. But large coastal and ocean-going vessels are starting to switch from diesel oil to fuel oil. Two reasons: Fuel cost savings more than offset higher maintenance costs; greater part of tonnage now building or on order is once again steam-driven (and fuel-oil fired). Rapid increase in size of ships calls for engine powers in excess of what is practicable for diesel engines to deliver.

Freer Trade Is a Two-Way Street

Proponents of freer trade can logically claim benefits to American business even from imports of the most sensitive materials.

In one recent year, reports the U. S. Chamber of Commerce, U. S. producers abroad supplied the following portions of typical U. S. imports: crude oil, 88%; aluminum, 96%; nickel, 87%; copper, 72%; iron, 85%; lead, 50%; paperbase stocks, 78%. All in all, says the Chamber, American companies overseas provided 23% of our commodity imports. Private investments abroad now total $35 billion.

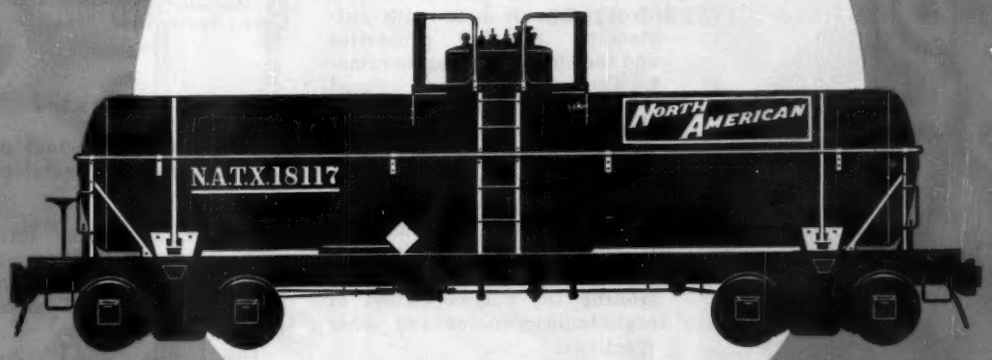
This American activity abroad should be further stimulated by the vote of the recent 85th Congress to extend the Trade Agreements Act for five years. Although hardly a body blow for protectionist champions, the extension does continue the President's authority to lower tariffs gradually and selectively in return for trade benefits from other countries.

The U. S. Chamber of Commerce claims other benefits for the Trade Agreements extension:

- It will protect and stimulate, in general, the foreign trade upon which an estimated 4.5 million U. S. jobs depend.
- It will help us meet Russia's government-subsidized trade drive.
- It's the answer to the threat of tariff barriers around the European Common Market, whose members stand ready to negotiate reciprocal tariff reductions.

LEADING

CHEMICAL SHIPPERS



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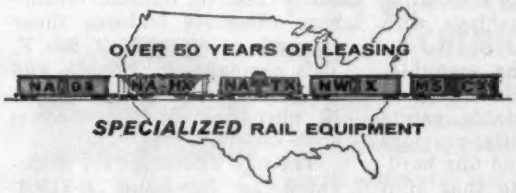
. . . YOU can, too!

Top companies rely on North American leased equipment for economical, investment-free shipping. You'll find our diversified fleet offers covered hoppers and tank cars especially designed for transporting *your* type of chemicals and allied products.

Remember—North American brings you specialized, first-hand, applied knowledge of bulk shipping by rail . . . backed by over half a century of experience in railroad car leasing. And we are ready to serve you and your company.



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DEVELOPMENTS . . .

CHEMICAL PRODUCTS EDITED BY FRANCES ARNE

Rigid Polyethylene

First use of plastics and non-round shape for cartridge cases.

Triangular plastic cartridge case has been developed for a new pistol said to embody the first major change in gun design in more than a century. Pistol will shortly be produced by Dardick Corp., Hamden, Conn.

The triangular case is made of Fortiflex, Celanese's rigid polyethylene. As far as is known, this is the first successful use of plastics for pistol and rifle cartridge cases and the first time that the cases have been made in shapes other than round.

The use of Fortiflex enhances the advantages of the new gun design by providing a superior gas seal and minimizing friction during feeding and ejection of the case. The plastic's elasticity permits expansion under high pressures without the case bursting and enables the ammunition to withstand severe abuse without deformation of the case. Its ability to expand within the firing chamber against the barrel face provides superior gas seal at all cylinder joints. — **Celanese Corp. of America, New York, N. Y. 70A**

Tri-n-butyl Phosphine

Antioxidant gets new commercial production.

Tri-n-butyl phosphine, a strong organic base with outstanding reducing properties and the ability to form coordination compounds, is now offered in commercial quantities.

Already in use as a gasoline additive, TBP shows promise as a diesel and furnace fuel additive, as an epoxy resin curing catalyst, in making vinyl and vinylidene esters, in polymerizing vinyl compounds and in controlling the polymerization of organic isocyanates and other reactions.

In addition to its value as an antioxidant, it is suggested as an intermediate in preparing oxide and sulfide derivatives and such addition compounds as phosphine metal or aryl halides, metal cyanides and metal carbonyls.—**Food Machinery & Chemical Corp., Chemicals & Plastics Div., New York. 70B**

PVAc-based Paint

New emulsion for glossy water-thinned paint.

Commercial production of a new polyvinyl acetate emulsion specifically designed as a vehicle in gloss and semi-gloss water based paints has recently started.

Durability of the paint film and of the gloss itself have been major problems of water based gloss paint. Paints based on the new vehicle, called Gelva TS-66, are said to stand up even after many frequent washings with soap and water.

According to the manufacturer, the new emulsion may be formulated into stable paints with a long shelf life, provides a degree of gloss and film hardness comparable to that of a quality oil formulation. And unlike present polyvinyl acetate emulsions for gloss (*Chem. Eng.*, Aug. 1957, p. 182), Gelva TS-66 does not require any special additives and may be compounded easily in regular emulsion paint equipment.—**Shawinigan Resins Corp., Springfield, Mass. 70C**

Metallic Stearates

Soap and surfactant products based on insoluble metallic stearates.

Company's regular line of soap and surfactant products has been expanded to include a growing number of metallic, fatty base complexes.

The family of Flexals are commercially pure formulated finished compounds based on insoluble metallic stearates. They are produced in a new simplified manufacturing process designed to eliminate many of the contaminants usually associated with similar materials.

Current quantity production is composed largely of sodium stearate and calcium stearate.

Limited pilot quantities of other Flexal products include: magnesium stearate, calcium oleate, lithium stearate and a modified water soluble lithium stearate. Other metallic, fatty base complexes are now under laboratory development.—**Swift & Co., Chicago. 70D**

Adhesives

With greater shear strength and high temperatures.

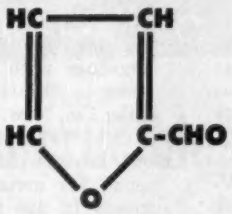
A new family of three synthetic-rubber, phenolic-resin-base adhesives features shear strength of 495 psi. at 600 F. This compares to 200 psi. and 220 psi. for the two other Buna N, phenolic-resin-base adhesives on the market.

The new adhesives are designated as Ray-Bond R-81001, 81002 and 81114. Used for rubber-to-metal, plastics-to-metal, metal-to-metal and friction ma-

A TECHNICAL MEMO FROM THE QUAKER OATS COMPANY ON

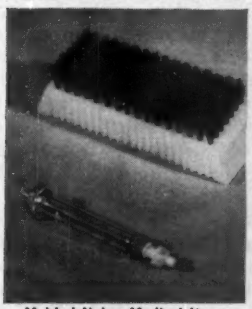
QO® FURFURAL AS A CHEMICAL INTERMEDIATE

Many chemists are intrigued with QO furfural as a chemical intermediate. To begin with, furfural's structural formula looks like this . . .

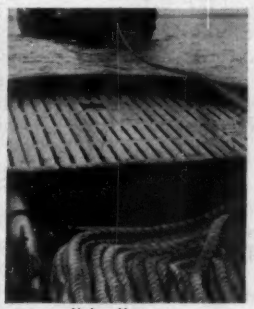


. . . and from this starting point, researchers can take off in a number of profitable directions.

THIS WAY TO NYLON



Molded Nylon Medical Items



Nylon Hawser

For example—decarbonylation of furfural over a zinc chromate catalyst in the presence of steam yields furan which may be hydrogenated to tetrahydrofuran. This undergoes ring opening with HC1 to form 1,4-dichlorobutane which is readily converted to other open chain compounds such as adiponitrile – $CN(CH_2)_4CN$. From here it's but a short step to hexamethylenediamine and then to nylon.

OTHER DIRECTIONS—OTHER PRODUCTS

Many other compounds of industrial importance—or potential importance—may be produced from furfural.

By way of illustration—nitration of furfural yields 5-nitrofurfural semicarbazone. This compound is used in the pharmaceutical field as a bactericide in human therapy—and in the veterinary field for treatment of coccidiosis in chickens and enteritis in swine.

CHEMICAL ONE-MAN BAND

"Versatile" is the word that best describes furfural. It's worth investigating as a selective solvent . . . as a reactive solvent and dispersant for resins . . . as a resin former. QO furfural is readily available at a low, stable price.

So start charting a course to new horizons by writing for literature. Please indicate your special interest so that we may supply appropriate information.

The Quaker Oats Company
CHEMICALS DIVISION

The Quaker Oats Company — CHEMICALS — QO — CHEMICALS — DIVISION

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In Europe:
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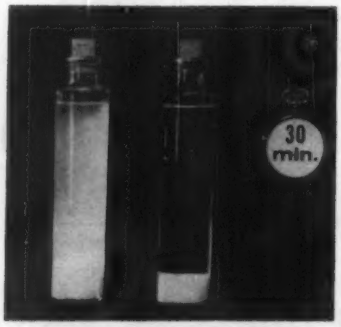
Quaker Oats (France) S. A., 3, Rue Pillet-Will, Paris IX, France;
A/S "Ota", Copenhagen, S. Denmark

In Australia:
Swift & Company, Ltd., Sydney

In Japan:
F. Kanematsu & Company, Ltd., Tokyo

terials bonding, all three of the adhesives are thermosetting. They differ from each other only in the percentages of solids they contain, providing a choice of viscosities. — **Raybestos-Manhattan, Bridgeport, Conn. 70E**



Emulsifying Agent

Superior suspension performance of treated aluminum silicate shown, above left, compared to $CaCO_3$.

Surface modified aluminum silicate pigments was tested for suspension performance in mineral spirits against precipitated $CaCO_3$ with results shown above.

Surface coatings, aimed at aqueous or organic systems use, make the pigments more hydrophilic or more organophilic.

Seven surface-treated aluminum silicate pigments available:

Particle Size, μ			Surface Treatment
0.55	0.8	4.8	
ASP 101			0.5% sterate
ASP 102	602		dispersing agent
ASP 103		403	organophilic surfactant
ASP 105		405	organophilic surfactant

Benefits of the surface treatment are: improved wettability, faster dispersion, increased suspension life, higher loadings with less viscosity increase.—**Minerals & Chemicals Corp. of America, Menlo Park, N. J. 72A**

Dyes

React fast with cellulosic fibers in presence of alkali.

Farbwerke Hoechst AG. has recently introduced the first examples of a novel class of dyes called Ramazol dyes. They represent a new and different system of fiber reactive dyes for printing and dyeing with quicker fixation and shorter rinsing time.

The specific novelty of the Ramazol dyestuffs is the ready, almost spontaneous, reactivity which they display for cellulosic fibers in the presence of alkali.

The first eight, a brilliant royal blue of excellent fastness to light and very good fastness to chlorine, and a black. All are dischargeable to a white.

Another new dye recently introduced by the company, PV-Fast-Bordeaux, is an organic pigment with outstanding fastness properties. It is especially suitable for the coloring of plastics.

Anthrasol Yellow 13R has been added to the Hoechst dyestuff series of Anthrasols. It is used in the dyeing of cotton, linen, regenerated cellulosic fibers as well as mixtures thereof and produces very fast ecrue and beige shades.—**Carbic Color & Chemical Co., New York. 72B**

Polyether

Sorbitol-based component for rigid polyurethane.

A new polyether, derived from sorbitol, is now available for use in making rigid polyurethane foam.

It has six hydroxyl groups available for cross-linking. Since rigid polyurethane foams can use up to 60% by weight of this new polyether, manufacturing costs can be reduced.—**Atlas Powder Co., Wilmington, Del. 72C**

BRIEFS

Molybdenum hexacarbonyl, tungsten hexacarbonyl and tungsten hexachloride have now been produced in semi-works quantities marking their first availability in sufficient supply for industrial application. Potential applications: vapor phase deposition of molybdenum and tungsten metals, catalysis and a variety of chemical reactions using these intermediates.—**Climax Molybdenum Co., New York, N. Y. 72D**

Textile finish, a modified urea-formaldehyde thermosetting resin, overcomes some of the major weakness of its class on cottons and rayons. Called Lyofix PR, it offers lower strength loss and less effect on lightfastness of dyeings, together with greater resistance to chlorine retention.—**Ciba Co., New York, N. Y. 72E**

First latex successfully developed for metal finishing, already in use as a primer by Ford Motor Co., has been reduced by 2¢ in price to 36½¢/lb. It's called latex 566.—**Dow Chemical, Midland, Mich. 72F**

Allyl chloride has been added to the company's product line at its Texas Div. which entered the allyl alcohol field earlier this year. A bifunctional chemical intermediate, the chloride reacts readily through the chlorine atom or the double bond.—**Dow Chemical Co., Midland, Mich. 72G**

Stickiness of a new family of adhesives is said to be beyond comparison with all other rubbery materials. Described as a polymer with built-in adhesive characteristics, new rubber-like cements differ radically in molecular structure. Called A-916-B, the pressure-sensitive thermoplastic material bonds new synthetic films to all kinds of metals as well as to paper, wood, glass, plaster and other materials without heat or special surface treatment.—**B. F. Goodrich Industrial Products Co., Akron, Ohio. 72H**

For More Information . . .
about any item in this department, circle its code number on the
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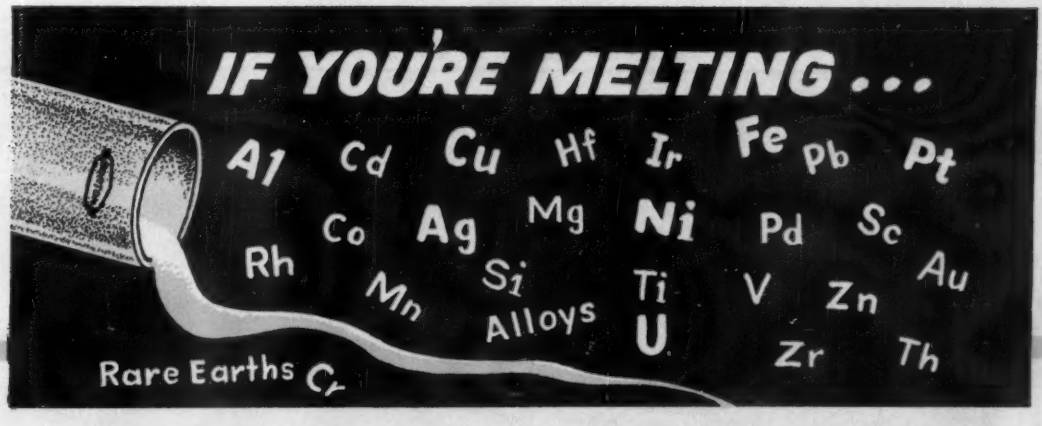

Norton crucibles, available in many materials, meet a wide range of needs

HEAVY WALL CRUCIBLES

Furnace Sizes in Pounds	Outside Diameters	Wall Thicknesses	Over-All Heights
½ to 300	1⅛" to 12¼"	⅛" to ⅜"	3½" to 16½"

Materials Available

ALUNDUM*	"A" 99% Alumina	All Sizes Shown	ZIRCONIA	"H" Fused Stabilized Zirconia	All Sizes Shown
CRYSTOLON†	"G" First Quality Silicon Carbide	All Sizes Shown	THORIA		½ to 50 lbs.
CRYSTOLON	"N" Nitride Bonded Silicon Carbide	All Sizes Shown	URANIA		½ to 50 lbs.
MAGNORITE*	"K" 97% Fused Magnesia	All Sizes Shown			

LIGHT WALL CRUCIBLES

Furnace Sizes in Pounds	Outside Diameters	Wall Thicknesses	Over-All Heights
½ to 50	1 3/32" to 5 13/16"	3/32" to 5/32"	3½" to 10 11/16"

Materials Available

ALUNDUM	"A" 99% Alumina	½ to 50 lbs.	ZIRCONIA	"H" Fused Stabilized Zirconia	½ to 50 lbs.
MAGNORITE	"M" 99% Fused Magnesia	½ to 50 lbs.	THORIA		½ to 17 lbs.

Norton crucibles are *engineered and prescribed* for a long list of metal melting operations. Available in a wide range of materials, sizes and types — as shown in the tables — they provide long, trouble-free service, protect your product purity and meet specific melting requirements.

Norton heavy wall crucibles, exceptionally strong and dense, are used for most induction furnace melting jobs. Thin wall crucibles, generally of lower porosity, are particularly suited for special and nuclear metallurgical processes. Their fine, smooth surface is particularly valuable for protecting high purity metals from refractory inclusions.

It will pay you to get further facts on this complete line of crucibles. For exact recommendations and all necessary details, contact your Norton Representative. Or write for new catalog, *"Norton Refractory Crucibles,"* to NORTON COMPANY, 511 New Bond Street, Worcester 6, Mass.

*Trade-Marks Reg. U. S. Pat. Off. and Foreign Countries

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REFRACTORIES
Engineered . . . Rx . . . Prescribed

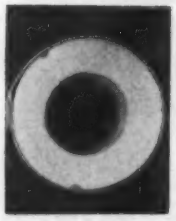
Making better products . . . to make your products better

NORTON PRODUCTS Abrasives • Grinding Wheels • Grinding Machines • Refractories • Electrochemicals — BEHR-MANNING DIVISION Coated Abrasives • Sharpening Stones • Pressure-Sensitive Tapes

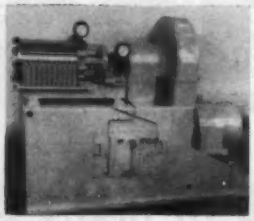
DEVELOPMENTS . . .

PROCESS EQUIPMENT EDITED BY C. C. VAN SOYE

Latest Developments



Pipe Insulation
Jacketed calcium silicate installs in 90 sec. *168A*

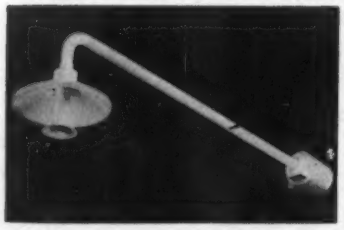


Continuous Reactor
Shaft-mounted beaters mix reactants flowing between heat transfer plates. *164A*

Cleaning Tool
Steel needles remove rust and scale from equipment, conform to surface. *165A*

Degasser
Ultrasonically expels gases from liquids. *167A*

Page number is also Reader Service Code Number



Temperature Sensor

Has shields to eliminate radiation error.

Triple shielding around a heat-sensing element permits air-temperature measurements substantially independent of solar and other radiation. Made of 0.003-in. stainless steel, the inner shield enclosing the element has a high surface-to-mass ratio. A second cylindrical shield of 0.062-in. aluminum surrounding this combination reduces effects of secondary radiation and provides mechanical protection. The third shield, hat-shaped in appearance, diminishes solar radiation error still further. Combined shielding is effective to a maximum temperature deviation of 0.2 F.

Located at the remote end of the mounting arm, a motor-blower combination serves as aspirator. Cost is $325 fob.—**Beckman & Whitley, Inc., San Carlos, Calif.** 74A

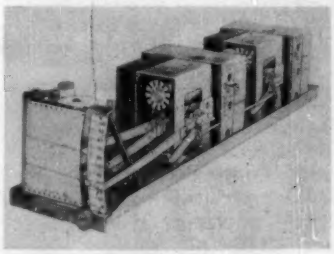
Vacuum Pump

Electronic unit operates on new principle.

Now in use at several research labs, the Evapor-ion pump creates "dry" vacuums in the pressure range of 10^{-4} to 10^{-9} mm. Hg. The word "dry" refers to the fact that the pump entirely eliminates the chance of vacuum-chamber contamination. Backstreaming of vapors, common to oil or mercury diffusion pumps, cannot possibly occur because Evapor-ion operates on an entirely new principal—the pump doesn't even have an outlet.

Titanium wire feeds onto a post heated by electron bombardment. The titanium evaporates and, upon striking the cooled pump wall, condenses as a thin layer. Chemically active gas molecules from the vacuum chamber wander into the pump, collide with the wall surface, and chemically unite with the titanium. Inert gas molecules entering the pump are ionized by bombarding electrons. An electric field drives the resulting ions into the titanium layer, where they are buried by subsequent condensation of titanium vapor.

Typical pumping speeds are 2,100 l./sec. for nitrogen, 1,000 l./sec. for oxygen and 3,000 l./sec. for hydrogen.—**Consolidated Electrodynamics Corp., Rochester, N. Y.** 74B



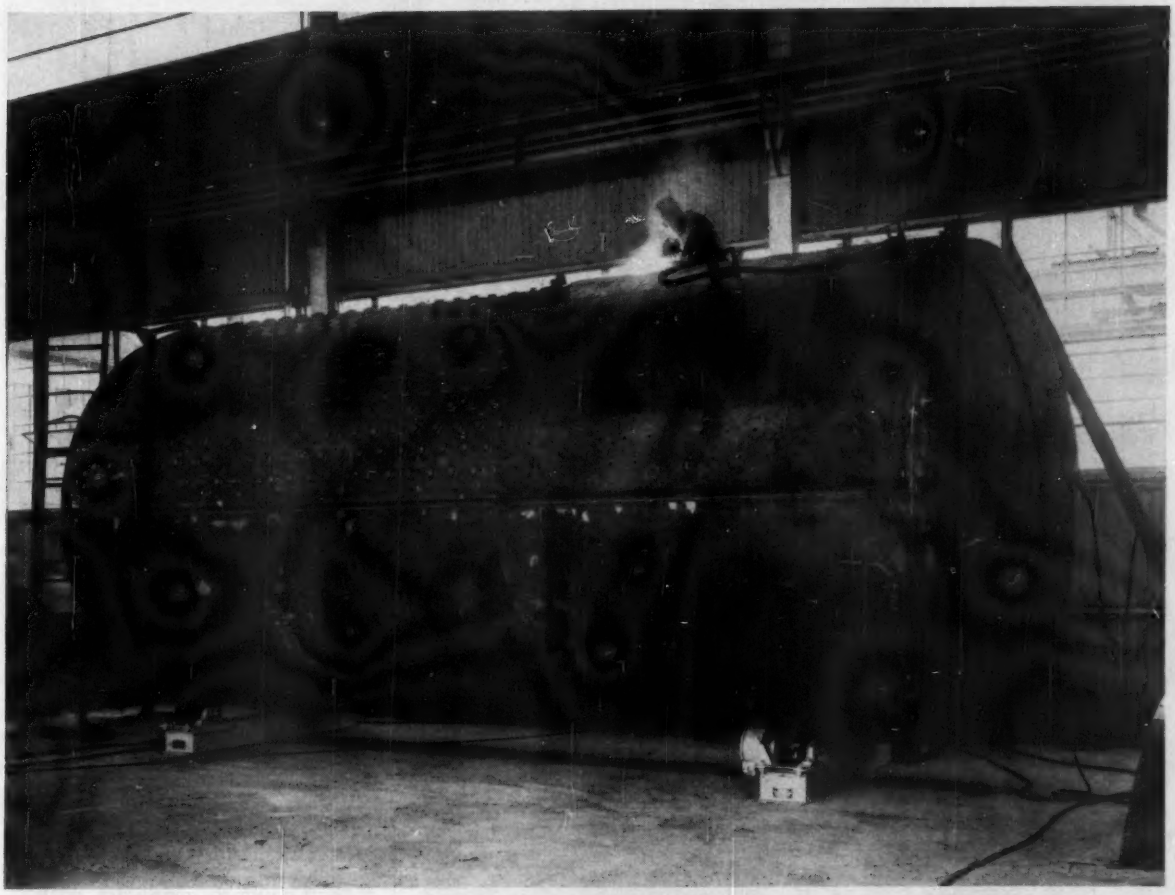
Miniature Recorder

Compact electronic instrument has two pens.

Latest member of the Autronic line of process control instruments, a new, all-electronic two-pen recorder enables users to keep tabs on a pair of related variables. Each pen has its own signal amplifier and actuating mechanism—all components mount on a single compact chassis. Alarm contacts, a control set point, or both are optional for one of the variables.

Instrument sensitivity is 0.1% or better; accuracy is ±½% of full scale. Housed in a standard 24-in. deep chassis, the re-

MTB Fabrication Fact Sheet



Hot Solution To A Storage Problem

A chemical manufacturer had a problem.

A liquid chemical had to be stored while awaiting truck and tank car pickup. Also, at normal temperatures it was impossible to keep the chemical from "salting out".

They needed a storage tank which would eliminate this problem. Missouri Boiler provided the answer in this 12'0" O.D. x 28'0" long Jacketed Tank. This vessel was designed for an external pressure of 125 p.s.i. @ 350°F. To solve the "salting out" problem the bottom 120° was steam jacketed using 788 stays welded to the tank and plug welded to the jacket. These stays were used to stiffen the shell to withstand the external pressure. The completed vessel was installed and the problem was solved.

Missouri Boiler has the experience and skill to custom fabricate to your needs. May we suggest that you add us to your bidder's list for steel and alloy plate fabrication from ¼" to 1¼". We think you'll be pleased with our better prices and dependable deliveries.

MTB

MISSOURI BOILER AND TANK COMPANY

Formerly Missouri Boiler and Sheet Iron Works

2218 Papin Street **St. Louis, Missouri**

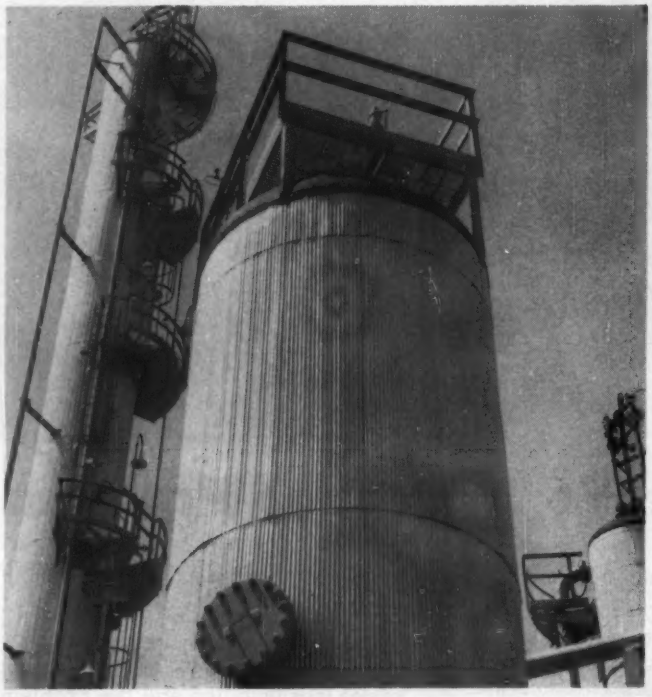
corder fits a 5-in.-square panel cutout.—**Swartwout Co., Cleveland, Ohio.** 74C

Level Gage

Odd vessel shapes present no problem.

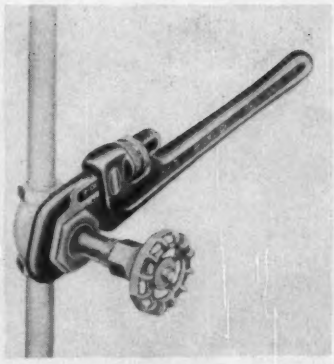
Applied nuclear radiation can give a true, continuous measure of liquid level or volume in totally enclosed containers, regardless of their size or shape. RCL's Model 40104 level gage does just this. Accuracy: a few hundredths of an inch.

Guided along a predetermined path inside the vessel, a small radioactive source contained in a float follows liquid level. Changes in level show up as variations of radiation intensity at a fixed scintillation detector outside the container. Detector output is calibrated as linear distance or volume.—**Radiation Counter Laboratories, Inc., Skokie, Ill.** 76A



Wrinkled Faces Depict Modernization, Not Old Age

These gleaming, silver-colored towers are the result of one recent modernization program at Phillips Petroleum's Sweeny, Tex. refinery. But good looks aren't the only benefit that the 97,953 sq. ft. of Childers' corrugated aluminum bestows on the plant. It also protects the valuable calcium silicate and cellular glass insulation that it covers. In addition to a pleasing appearance and mechanical strength, the jacketing features a factory-attached moisture barrier that cuts down on installation time. Available in four thicknesses, jackets come with both 1½- and 2½-in. corrugations. Sheet widths are 26 or 33 in., and lengths range from 6 to 12 ft.—**Childers Mfg. Co., Houston, Tex.** 76B



Hex Wrench

Has angular jaws for hexagonal nuts and fittings.

For a positive grip on rough or finished hex nuts, valvepacking nuts and unions, the new Hex Wrench has a special adjustable four-sided jaw that gives positive grip. The angular jaw of the heavy-duty tool is also said to give more leverage than standard wrenches. Hex Wrenches come in three sizes: No. 11 for ⅜ to ¾ in., No. 17 for ⅝ to 1¼ in. and No. 25 for 1 to 2 in.—**Ridge Tool Co., Elyria, Ohio.** 76C

Ratio Regulator

Combines simplicity with accuracy, versatility.

Claimed to be a new and fundamentally different device, the Type R liquid ratio regulator and blender automatically proportions and blends a secondary stream to the measured flow of an uncontrolled primary stream, despite line pressure fluctuations. The unit has only two moving parts, operates with a minimum pressure difference of 5 psi., requires no outside power source and no straight runs of approach or discharge piping. Only adjustment is a calibrated ratio dial.

Accuracy and split-second response are uniform throughout a 5:1 ratio range and a 2:1 primary flow range. Carbon steel, stainless and special alloy construction. — **The W. A. Kates Co., Deerfield, Ill.** 76D

Continuous Reactor and other equipment news on page 164.

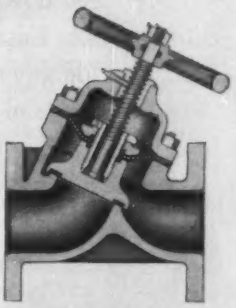
Crane diaphragm valves solve maintenance problem in bleach plant

Nine years ago, in this midwest paper mill, a 2-inch Crane iron-body, packless diaphragm valve was installed on a line handling a chlorinated lime solution in the bleach plant. Ever since, this valve has been in daily use without a sign of leakage. It still operates as easily—and seats tightly—as the day it was installed.

Impressed by the operating record of this first valve, the mill has a program for replacing all cocks on this service with Crane diaphragm valves.

Working parts of these Crane valves are not exposed to corrosive-erosive fluids as in the plug-type and conventional valves. The Crane diaphragm seals the bonnet completely, and functions *only* as a bonnet seal. Sticking and leakage are prevented. Diaphragm life is greatly prolonged since it is not subject to crushing, severe flexing—and early rupture—as in other diaphragm valves.

For complete facts about the complete line of Crane packless diaphragm valves for handling ordinary or corrosive process fluids, ask your Crane Representative.



Crane packless diaphragm valves are made in a wide variety of body materials, including choice of diaphragm, disc insert and optional body lining. Sizes: ½ to 14 in.—with screwed or flanged ends.

CRANE VALVES & FITTINGS

PIPE • PLUMBING • HEATING • AIR CONDITIONING

Since 1855—Crane Co., General Offices: Chicago 5, Ill.—Branches and Wholesalers Serving All Areas

WHOOSH!

MOHAWK BRUSH *relies on*

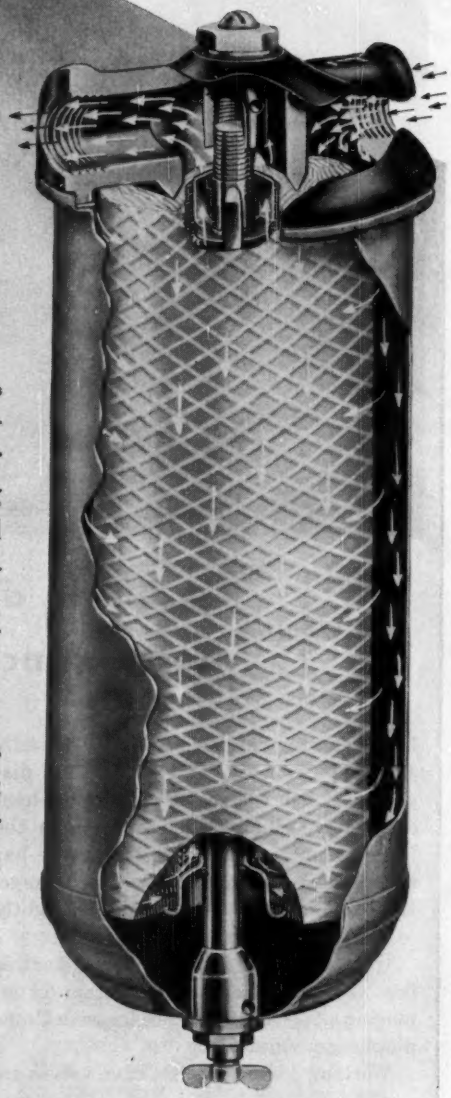
Fulflo Filters

to prevent clogging of tiny Aerosol nozzles

To assure proper operation of aerosol containers, minute valve orifices must be free from micro-contaminants. Mohawk Brush Company (Division of Fuller Brush) avoids trouble before it starts — by removing microscopic particles from insecticides, deodorants, and moth-proofing fluids with *Fulflo Filters*. Improved product quality and customer satisfaction are assured. In manufacturing, substantial savings are made because of reduced downtime.

Fulflo Filters, with genuine Honeycomb Filter Tubes, provide any desired degree of micro-clarity for all types of industrial fluids: liquid chemicals; pharmaceuticals; water; oils; liquid fuels; compressed air, CO_2 and other gases. They give true depth filtration, at minimum pressure drop, for high or low flow rate, pressure, pH, temperature and viscosity. Complete engineering facilities are at your service.

Write for new catalog to Department CE.



COMMERCIAL FILTERS CORPORATION
MELROSE 76, MASSACHUSETTS
PLANTS IN MELROSE, MASSACHUSETTS AND LEBANON, INDIANA

MICRO-CLARITY AT MINIMUM COST

Fulflo FILTERS
with genuine Honeycomb Filter Tubes for controlled micro-clarity of industrial fluids.

CFC FILTERS
Selective filtration of oils • water-oil separators • magnetic separators • pre-coat filters • coolant clarifiers • automatic tubular conveyors.

How Much Steam Should a Steam Trap Trap?

. . . some answers to commonly asked questions about the primary job of a steam trap

You don't need a doctor's degree in thermodynamics to answer the question at the top of this page. Naturally, a steam trap should trap *all* the steam.

Unfortunately for you, the problem isn't quite that simple. After all, a shut off valve would trap all the steam . . . and condensate, and air, and carbon dioxide as well.

So we'd better amend the answer to the question this way: A steam trap should trap *all* the steam but *must* remove condensate, air and carbon dioxide as rapidly as they accumulate.

With this established, let's take a closer look at what's involved:

A Steam Trap Should Trap All The Steam

If you've had experience with several different makes of traps, you already know that some trap steam better than others. The operating principle of the trap is what makes the difference. We like to talk about it because Armstrong traps are designed so that no steam can get to the orifice. The valve is always water sealed. Result: *More efficient steam utilization, lower fuel costs.*

A Steam Trap Should Remove Condensate

All traps remove condensate—after a fashion. For maximum efficiency in the unit being drained, though, the trick is to get it out without waiting for it to cool and without leaking steam.

Armstrong's water sealed valve takes care of steam leakage. The inverted bucket operating principle opens the trap for water regardless of its temperature. This means you get the condensate out as quickly as it accumulates. Result: *Higher temperatures and better heat transfer in steam heated units.*

A Steam Trap Should Remove Air and CO_2

Part and parcel of the condensate removal problem is removal of air as well as oxygen and carbon dioxide—two real troublemakers. Air tends to reduce operating temperatures and interfere with heat transfer. CO_2 goes into solution to form corrosive carbonic acid which, for example, can eat unit heater tubes. O_2 aggravates the situation. Believe it or not, but all traps don't properly remove air and CO_2.

By now, you've probably guessed that Armstrong traps *do* remove air and CO_2. Armstrong design (see illustration) provides continuous venting of air and CO_2. By opening suddenly, the Armstrong trap creates a momentary pressure drop to "pump" the air down to be vented. Result: *Higher temperatures, faster heat-up, better heat transfer and reduced corrosion.*

Note: When required, specially sized air vents are furnished. For fast heat-up of low pressure on-and-off units, Armstrong provides open float and thermostatic air vent traps.

What's the Final Answer?

Summing it all up, you'll get the best service from steam heated units that are equipped with traps designed to trap *all* the steam and remove air and condensate as quickly as it accumulates. In our prejudiced viewpoint, this means Armstrong traps. More important are the several thousand users of Armstrong traps who have proved the point.

Before you make up your mind, though, consider the minimum maintenance requirements of Armstrong traps . . . and the convenient assistance your local Armstrong Representative provides. These are important plus values.

Put Up or Shut Up

We're so confident that we "put up". Armstrong traps are unconditionally guaranteed to satisfy. So you can find out for yourself with practically no risk. If you're not completely satisfied with the way they do their job, you can get your money back.

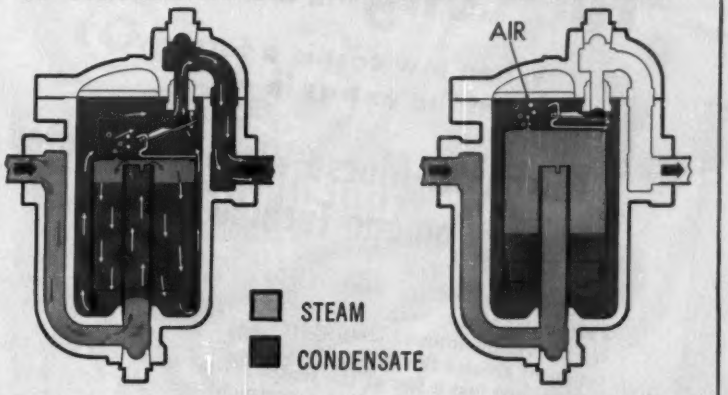
* * *

The 44-page Armstrong Steam Trap book goes into greater detail on these and other Armstrong features. It also discusses trap selection, installation and maintenance. Ask your Armstrong Representative for a copy or write

Armstrong Machine Works
8586 Maple Street
Three Rivers, Michigan

ARMSTRONG STEAM TRAPS

HERE'S THE STEAM TRAP DESIGN THAT GETS RID OF CONDENSATE AND AIR WITHOUT STEAM LOSS



Trap open. Condensate entering trap has caused bucket to lose buoyancy. Weight of bucket times leverage pulls valve open. Air is discharged along with condensate.

Trap closed. Steam has floated inverted bucket; valve is held tightly closed by system pressure. Air entering trap passes through bucket vent and accumulates at top of trap.

Bargain Priced Over The Long-Term Haul!

When low cost is a factor you'll want the extras in a...

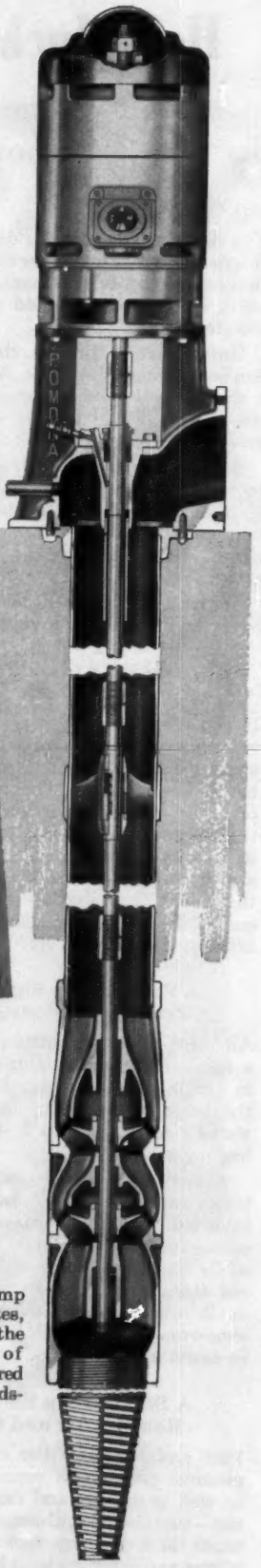
Fairbanks-Morse Water Lubricated Pomona Turbine Pump

Low price is only the beginning with this rugged turbine pump. Fairbanks-Morse built-in features keep annual costs even lower by providing longer, trouble-free performance; simplified maintenance; greater flexibility.

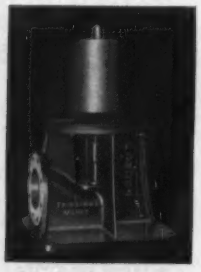
Here are just a few of the features that make the F-M Pomona Pump such an outstanding investment for your deep well water supply:

- Water lubrication. Packing box, impeller adjustments above ground; can be reached without interrupting pump service
- Two piece head shaft facilitates installation and service
- Stilling tube keeps suspended material out of packing box
- Special bearings, bearing retainers and pump bowls designed for maximum efficiency and long life

Contact your F-M Pomona Dealer or Fairbanks-Morse Sales Engineer today. Ask for new illustrated Bulletin 6957-1. Or write Fairbanks, Morse & Co., 600 So. Michigan Ave., Chicago 5, Ill.

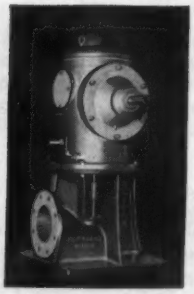


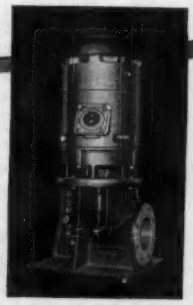
So Easy To Change Drives...



BELTED

GEARED





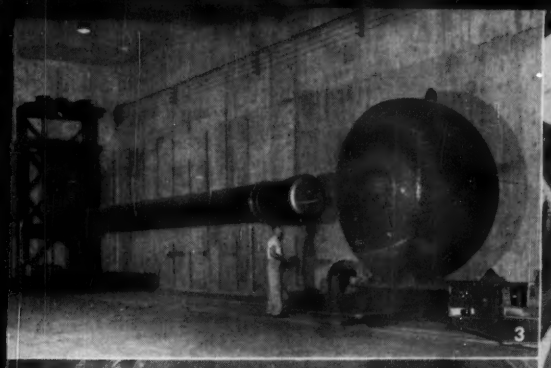
ELECTRIC

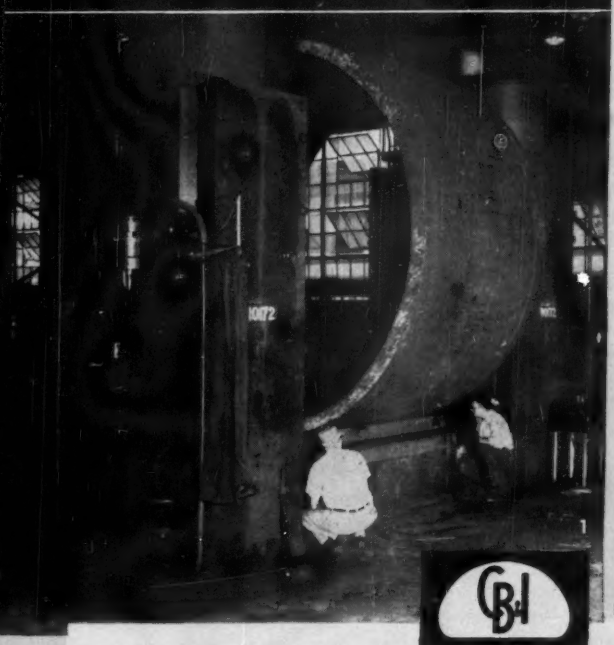
Seven Fairbanks-Morse pump factories in the United States, Canada and Mexico build the world's greatest variety of hydraulic combinations offered by any manufacturer of liquids-moving machinery.

FAIRBANKS-MORSE

a name worth remembering when you want the BEST

PUMPS • SCALES • DIESEL LOCOMOTIVES AND ENGINES • ELECTRICAL MACHINERY • RAIL CARS • HOME WATER SERVICE EQUIPMENT • MAGNETOS





Craftsmanship Counts at CB&I ...

Almost 70 years of specialization in the design, engineering, fabrication and erection of steel plate structures will build long and efficient performance life into your next CB&I-built storage or processing structure. Here's why:

CB&I Engineers From first contact with the customer through final testing, CB&I's general engineering staff supplies technical guidance to the CB&I team. Important coordination between fabricating, erection and testing of your structure is thus insured.

CB&I Fabricates The finest manufacturing facilities—including X-ray and stress relieving—backed by metallurgical laboratories and testing facilities second to none—are maintained in four strategically located and fully equipped fabricating plants.

CB&I Erects Skilled, responsible crews work with up-to-date equipment. Field X-ray and stress relieving equipment, backed by welding research laboratories, are an important part of their trade. Experience in a wide variety of metals, including stainless, nickel, aluminum and clad materials are also part of the service that has earned CB&I a *global* reputation for erecting on a *world-wide* basis.

These coordinated services are what you receive when you contract for a CB&I-built structure. CB&I customers have learned to expect and get top rated performance and maximum service life from CB&I *craftsmanship in steel*. Write our nearest office for details. Ask for the CB&I Bulletins on: *Special Plate Structures* and *CB&I Field Services*.

P73CB

Chicago Bridge & Iron Company

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Plants in BIRMINGHAM, CHICAGO, SALT LAKE CITY, GREENVILLE, PA. and at NEW CASTLE, DELAWARE.
In Canada: HORTON STEEL WORKS LTD., TORONTO, ONTARIO
REPRESENTATIVES AND LICENSEES:
Australia, Cuba, England, France, Germany, Italy, Japan, Netherlands, Scotland

1. 5-in. thick plate for reactor is fabricated at CB&I's Birmingham, Alabama plant.

2. Workman smooths seams on an assembled section.

3. X-ray machine for checking seam welds. Machines operating at 1,000,000 and 2,000,000 volts are used to completely inspect steel vessels as much as 10 inches thick.

4. 72-ton top section for reactor-regenerator is lowered into position under supervision of CB&I erection specialist.

WHEELS

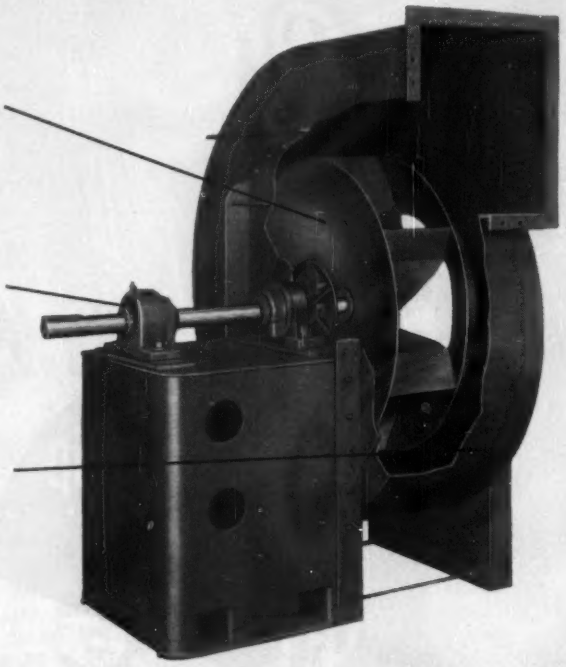
Welded steel construction. One-piece, cone-shaped rims and hubplates, standard or extra-heavy.

BEARINGS

Heavy-duty, self-aligning ball or tapered roller bearings for quiet operation, dependability, long life.

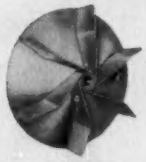
HOUSINGS

Heavy welded sheet steel or plate, adjustable discharge in sizes thru 37" inlet. Fixed discharge on larger sizes. Externally braced for maximum rigidity.



AIR HANDLING
Type AH

MATERIAL HANDLING
Type MH

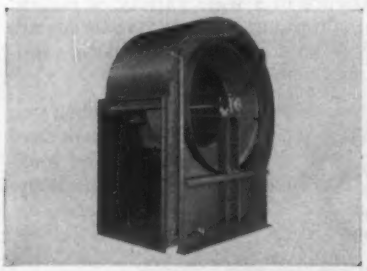


LONG SHAVINGS
Type LS

Handle any one of 3 basic processes with an American Blower Industrial Fan

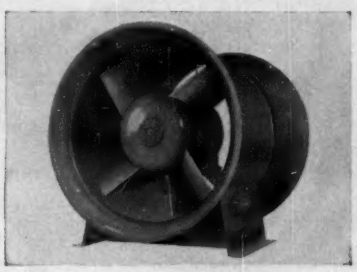
Here's a practical way to solve tough process applications: an American Blower Industrial Fan. It's available with three types of wheels to let you handle air, gases, or air and gases containing material, or long shavings. And there's a wide range of fan arrangements, optional constructions — for severe duties or high-temperature operations — and optional accessories to allow fan modification for individual jobs. Equipment selection and application assistance is available, should you need it, from our 73 engineer-staffed branch offices. A phone call is all it takes to get full product information. American-Standard,* American Blower Division, Detroit 32, Mich. In Canada: Canadian Sirocco products, Windsor, Ontario.

It pays to standardize on American Blower fans for every duty!



HS Fans—direct or V-belt drive, medium-speed operation; nonoverloading.

Sirocco Fans—low speed, quiet operation; move more air per revolution.



Axial Fans—move high volumes in minimum space; flexible installation.

* American-Standard and Standard® are trademarks of American Radiator & Standard Sanitary Corporation.

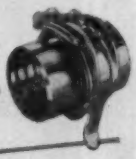
AMERICAN-Standard
AMERICAN BLOWER DIVISION

Let us show you how TRI-CLOVER Stainless Steel FITTINGS and PUMPS can help solve your CORROSION-RESISTANT PIPING and PUMPING PROBLEMS

For many years, Tri-Clover Division has specialized in the design and manufacture of stainless steel and Trialloy fittings, valves, pumps and custom specialties, serving the broad chemical-process industries.

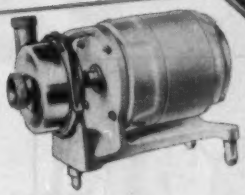
Your selection of the *right* fittings, valves, pumps, and tubing for any specific application is made easier by Tri-Clover Division's complete production and engineering facilities. Completely equipped metallurgical engineering and research laboratories are your assurance of *Controlled Quality* products. Here is one dependable source fully qualified to help you solve your corrosion-resistant piping and pumping problems.

Sanitary type stainless steel fittings and valves are available in a complete range of types and sizes.



"TRI-CLAMP"® stainless steel fittings for both "permanent" and "take-down" liquid conveying lines in a wide range of types and sizes.

A full line of stainless steel tubing and pipe is available in a complete range of sizes.



Tri-Clover sanitary and industrial type centrifugal pumps are built for broad corrosion-resistant pumping service.

See your nearest TRI-CLOVER DISTRIBUTOR

Export Dept.: 8 S. Michigan Ave., Chicago 3, U.S.A.
Cable: TRICLO

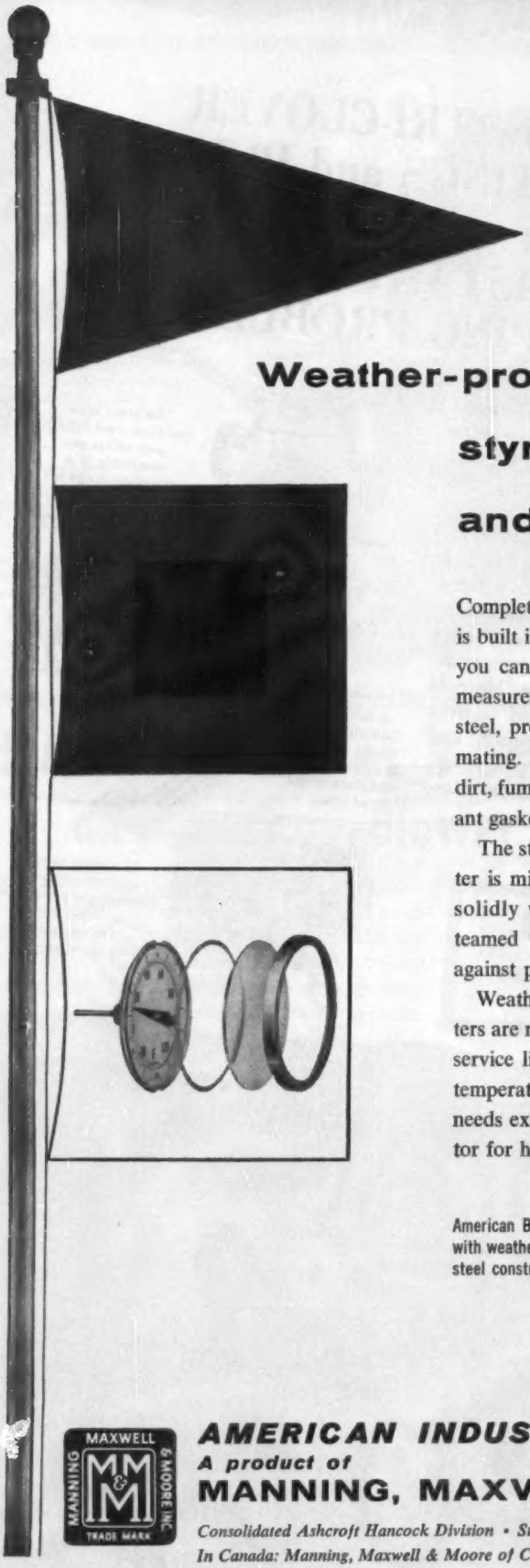
In Canada: Brantford, Ontario

LADISH CO.
Tri-Clover Division
Kenosha Wisconsin

TRI-CLOVER

1-257

Typical installation of Tri-Clover industrial pumps and fittings serving a large pharmaceutical plant.



Weather-proof construction stymies erosion and corrosion

Complete protection against erosion and corrosion is built into American Bi-Metal Thermometers, so you can always be sure of accurate temperature measurement. Both case and bezel are stainless steel, precisely fitted and gasketed to insure snug mating. Whatever the weather, rain, sand, dust, dirt, fumes and frost are sealed out by a heat-resistant gasket between case and thick cover glass.

The stem of the American Bi-Metal Thermometer is mirror-smooth stainless steel. All joints are solidly welded. Top resistance to corrosion is teamed with strength, rigidity and tight closure against process pressures.

Weather-proof American Bi-Metal Thermometers are noted for high sustained accuracy and long service life. There are mounting styles, dial sizes, temperature ranges and stem lengths to meet your needs exactly. Ask your industrial supply distributor for help in proper selection.

American Bi-Metal Thermometer with weather-proof stainless steel construction.

AMERICAN INDUSTRIAL THERMOMETERS
A product of
MANNING, MAXWELL & MOORE, INC.

Consolidated Ashcroft Hancock Division • Stratford, Connecticut
In Canada: Manning, Maxwell & Moore of Canada, Ltd., Galt, Ontario

You should know more about the new ACF non-lubricated Ball Valve

Now, while you're thinking about it, ask your secretary to have us send you Catalog 1000.

This catalog will give you a full description of the latest product of W-K-M's creative engineering—the ACF non-lubricated Ball Valve.

This new valve was service-tested for 3½ years before it was offered to buyers. Service-*tested* and service-*proved*: in the entire 3½ years, every user reported completely satisfactory results.

It's a great valve, this new one: versatile, rugged, efficient, easy to maintain on those rare occasions when maintenance becomes necessary, a valve you can specify with complete confidence.

So send for Catalog 1000—you should know more about this *new* valve.

Product of W-K-M's *Creative Engineering*

This cut-away picture shows you why this new valve performs so dependably, lasts so long, and is so economical to maintain.

Note the full, round conduit through body and ball that assures full flow through the valve—without turbulence, and with no more pressure drop than through an equivalent length of pipe.

Note the way the ball is suspended between Teflon seats under compression, assuring leakproof service at rated working pressures, or under vacuum, indefinitely.

Note the way actual seating surfaces are sealed away and protected from any abrasive action of the lading flow in either open or closed position.

Available in carbon steel (ASA 150 lb., 300 lb.), and semi-steel (200 lb., 400 lb.). Sizes range from ½" through 6". See Catalog 1000 for full listing of sizes and pressures.

W-K-M

DIVISION OF ACF INDUSTRIES
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P. O. BOX 2117, HOUSTON, TEXAS
Export Office: 45 ROCKEFELLER PLAZA, NEW YORK, N.Y.

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FLUORIDES

manufactured
in one of the
largest facilities
in the world

Unloading mineral fluospar which comes to us from various parts of the world.

Write for your free copy of M.C.A. Chemical Safety Data Sheet SD-25 on properties and essential information about HYDROFLUORIC ACID Anhydrous and Aqueous.

BORON TRIFLUORIDE
HYDROFLUORIC ACID
ANHYDROUS...AQUEOUS

and a long list of other production-controlled high-quality fluorides

Ammonium Bifluoride
Ammonium Fluoborate
Antimony Trifluoride Sublimed
Barium Fluoride
Bismuth Fluoride
Boron Trifluoride
Boron Trifluoride Complexes
Cadmium Fluoborate
Chromium Fluoride
Copper Fluoborate
Fluoboric Acid
Fluorine Cells
Fluorinating Agents
Frosting Mixtures
Hydrofluoric Acid Anhydrous
Hydrofluoric Acid Aqueous
Hydrofluosilicic Acid
Lead Fluoborate
Metallic Fluoborates
Nickel Fluoborate
Potassium Bifluoride
Potassium Chromium Fluoride
Potassium Fluoborate
Potassium Fluoride
Potassium Titanium Fluoride
Silico Fluorides
Sodium Fluoborate
Tin Fluoborate
Zinc Fluoborate
Zinc Fluoride

If required you are invited to draw on the knowledge and experience of our staff of technical specialists on fluorides.

The Harshaw Chemical Company

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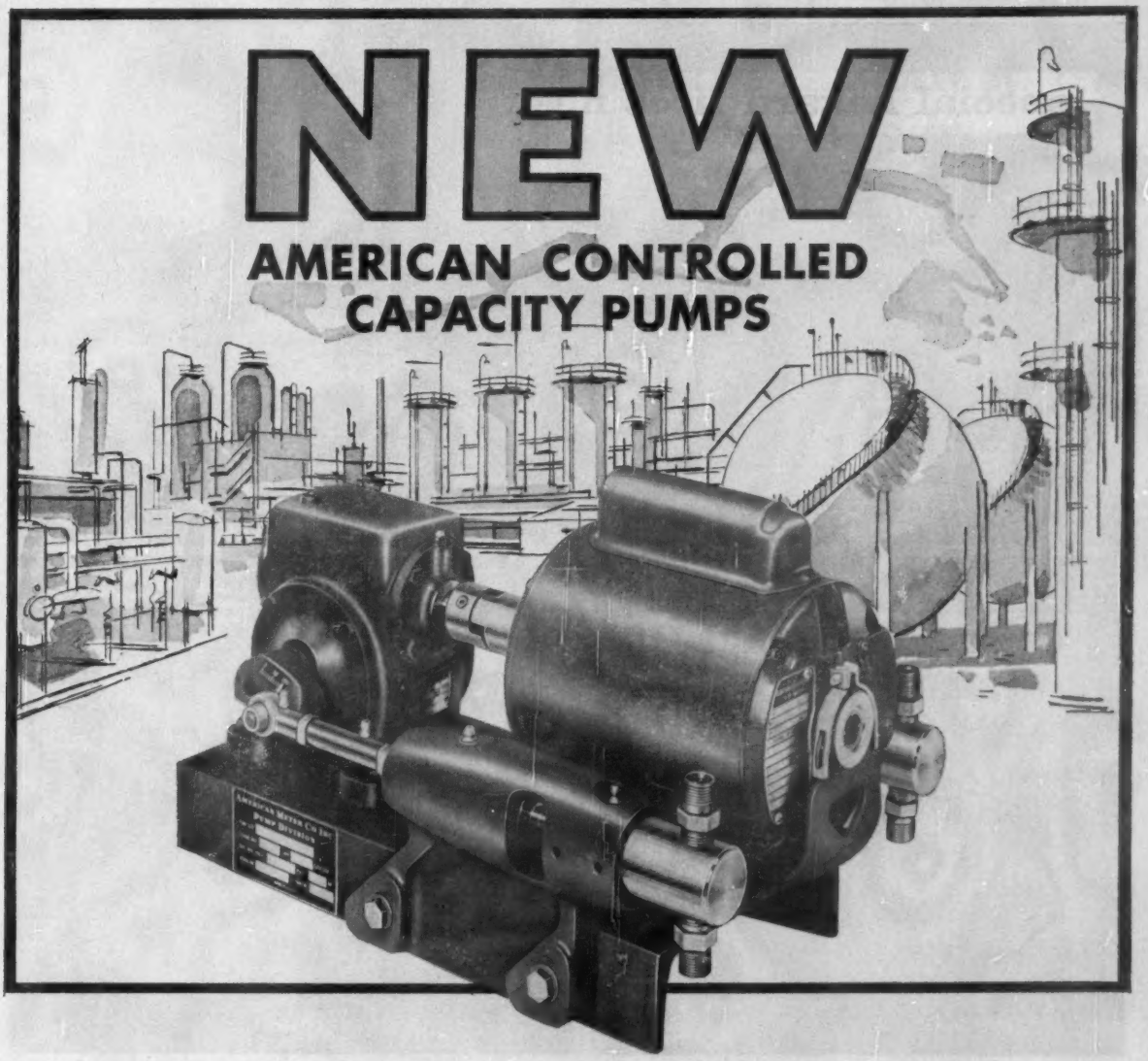
HASTINGS-ON-HUDSON, N. Y. • PHILADELPHIA • PITTSBURGH

NEW

AMERICAN CONTROLLED CAPACITY PUMPS



JOB ENGINEERED FOR LONG-TERM ACCURACY AND LOWEST MAINTENANCE COSTS

New American controlled capacity pumps are precision built to meet the needs of Chemical Processing, Refining and Boiler Feed applications.

Quality construction assures the highest accuracy in feeding precisely metered fluids or slurries into low or high pressure systems in virtually all desired ratios, with flow, temperature, pressure, conductivity, PH and other controlled process variables. Control may be manual or automatic – with electric, hydraulic or pneumatic systems.

Newly designed models are available to handle a wide variety of "tough," corrosive and viscous materials, with long-term accuracy and economy.

Write today for full information on American's new controlled capacity pumps. They're sure to meet *your* fluid proportioning requirements.

PUMP DIVISION

american meter company

High Pressure Pumps • Controlled Capacity Pumps • Chemical Feed Systems

13500 Philmont Avenue, Philadelphia 16, Pennsylvania

Fairly commonplace in industry today are special hazard areas, where special protection must be provided to assure against possible serious loss by fire. Grinnell, with 88 years' experience protecting against fire hazards of every description, has the most effective extinguishing agents and best systems for each type of hazard.

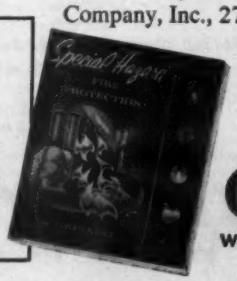
Remember, too, the installation of the proper Grinnell System usually serves to reduce fire insurance premiums drastically, often pays for itself in a few years!

TABLE OF CONTENTS

- Recognizing Your Special Hazards
- The Fire Triangle in Special Hazard Fire Protection
- Special Hazard Fire Terms Defined
- Water Spray Systems
- Selfcon Water Spray Systems
- Foam Systems
- Carbon Dioxide Systems
- Dry Chemical Systems
- Control Equipment and Devices
- Quick Selector Chart
- Research and Testing
- Sales, Engineering, Installation and Inspection Service

FREE REFERENCE MANUAL! This new 44-page reference manual — "Special Hazard Fire Protection by Grinnell" — gives you a comprehensive picture of all the most advanced methods for Special Hazard fire protection. It includes explanations, applications, photographs, case histories of Grinnell systems and specialized equipment . . . and a Quick Selector Chart to help you determine the most effective system for your special fire hazard.

Write for your complimentary copy today. Grinnell Company, Inc., 277 West Exchange St., Providence, R. I.



GRINNELL

WHENEVER FIRE PROTECTION IS INVOLVED

Manufacturing, Engineering, and Installation of Fire Protection Systems since 1870

Simplicity in steam traps can effect big savings in parts inventory and maintenance time

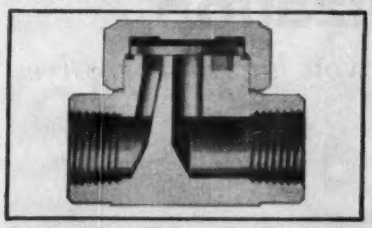
by John W. Ritter, Test Engineer
SARCO Company, Inc.

The function of all steam traps is to release condensate and prevent steam loss. However, the method of trapping can make a great difference in cost and effectiveness.

In the Sarco Thermo-Dynamic Steam Trap, the method is fundamental. Air or condensate entering the trap must flow from the inlet tube, radially across the underside of the disc valve, to the outlet. The space between the inlet tube and the disc forms a nozzle in which the static pressure energy of the incoming fluid is partly changed to velocity across the underside of the disc, with a resultant *decrease* in pressure. (This will be recognized, of course, as the Bernoulli Principle.) Use of this fundamental method means reliability in operation.

As the high velocity fluid jet strikes the side of the upper chamber, some recompression takes place, so that the pressure above the disc becomes greater than the pressure below it. The pressure reduction under the disc and the pressure recovery above it depend on the internal energy of the fluid. As the condensate above nearly approaches steam temperature, its internal energy is enough to overcome the upward force at the inlet tube and the disc snaps down in the inlet tube, which is the inlet valve seat.

Simultaneously, the disc also seals the outer ring, which isolates the space above the disc from the outlet. The disc valve is therefore held firmly against the inlet valve seat until the pressure in the control chamber is reduced by condensation. The upward force then exceeds the downward force and the disc valve opens.



This 3-part Sarco TD Steam Trap has only one moving part—the hardened, polished stainless steel disc.

No other trap uses the velocity of the fluid to operate the valve or uses the recompression of the flowing fluid to trap the valve closed and to hold it closed. When it closes, it closes tightly – no "operating steam" leaks out.

40 seconds inspection time— that's all it takes for a SARCO TD Steam Trap

Just back off the cap of a Sarco TD. Lift out its single moving part, the stainless steel disc. Wipe it off, and drop it back. No adjustment is ever required, at any load or any pressure in its range – from 10 through 600 psi.

The TD operates in any position, won't blow steam at any load. Small as a tee fitting, it can be installed in tight places. Its versatility and reliability cut cost of big replacement inventory.

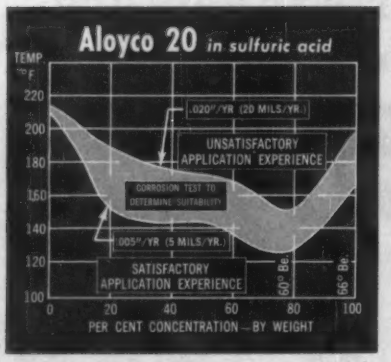
Write for "Literature Kit 2A" today and get latest bulletins on the TD Steam Trap and other Sarco steam traps. Remember that Sarco can give you impartial advice on *Production Planned steam trapping* because . . .

5605-B

SARCO
COMPANY, INC.
635 Madison Ave., New York 22, N. Y.

Only Sarco makes all 5 types:
Thermostatic • Liquid Expansion • Float Thermostatic
Thermo-Dynamic • Bucket

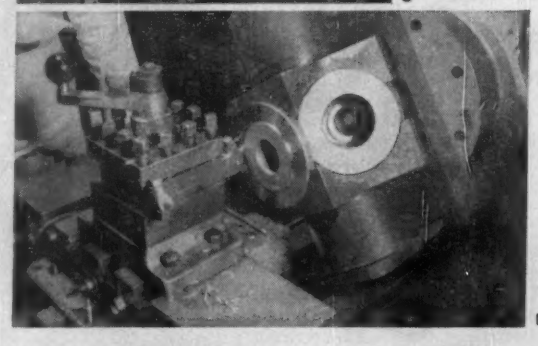
STEAM TRAPS • TEMPERATURE CONTROLLERS • STRAINERS • HEATING SPECIALTIES



B

A

C



D

A. Your Problem in handling corrosives is discussed with a specialist when you sit down with an Aloyco Sales Engineer. He handles only one line, knows his business.

B. Right Alloy for your application is based on 29 years of specialized experience in the field plus continuing research in Aloyco metallurgical labs.

C. Valve Casting is made from Aloyco design in Aloyco foundry, only foundry ever built to produce pressure-tight Stainless Steel Valve castings, exclusively.

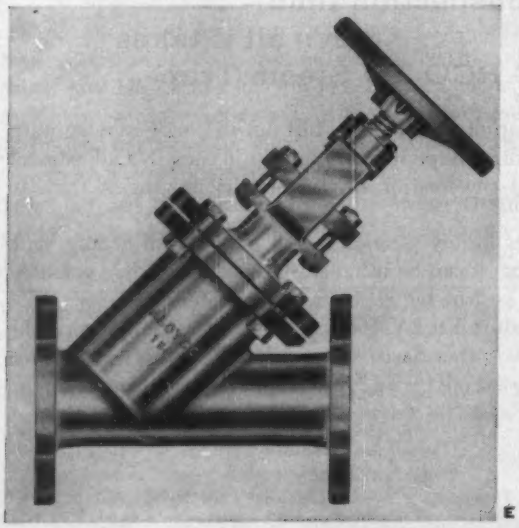
D. Special Techniques in machining stainless steel, plus most modern equipment in Aloyco plant assure you precise tolerances, trouble-free performance.

E. Aloyco Y Valve, shown here in various stages of production, is one of Aloyco's complete line of valve types, alloys, sizes, pressures—including nuclear valves.

BEHIND EVERY ALOYCO VALVE...

specialization

... to help you handle corrosives



E

Valves often look alike—even stainless steel valves. But they won't necessarily perform alike when you get them into the line.

Here are some of the special skills and facilities that make the difference between Aloyco valves and others. Some of the "extras" you get with Aloyco valves are staying power, minimum maintenance, trouble-free operation in severe as well as mild corrosive service. Doesn't it make sense that the one company specializing in the manufacture of Stainless Steel Valves exclusively is your best source of supply?

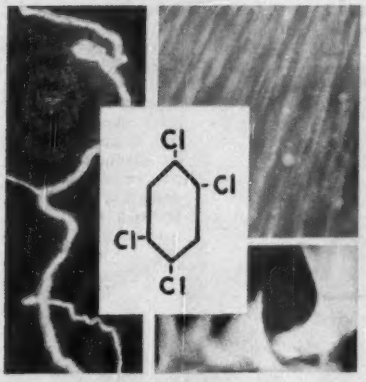
8.2

ALLOY STEEL PRODUCTS COMPANY

1301 West Elizabeth Avenue, Linden, New Jersey

BRIEFS

on a new way to look at tetrachlorobenzene... some facts about phosphoric anhydride... a better grade of lauryl chloride... the care and packaging of caustic potash



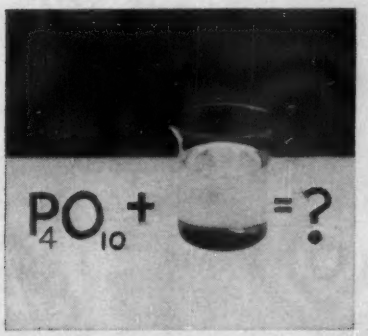
Chlorocarbon-of-all-trades

When you're looking for the stability, the resistance to fire and moisture, or the electrical properties of chlorinated aromatics, take a long look at our 1,2,4,5-tetrachlorobenzene.

Here you have a compound that's 65.7% chlorine, with a molecular weight of 215.9; a compound you can dissolve in most anything but water.

It's easy to handle. A white crystalline solid with very little odor.

It has many more interesting properties, all of them given in the technical data sheet offered in the coupon.



Is phosphoric anhydride more than a thirsty powder?

Stick to the textbooks and you'll write off our phosphoric anhydride P_2O_5 (P_4O_{10}) as just a rather strong desiccant.

Keep an open mind, though, and like many you may find it useful as a highly pure carrier of phosphorus, useful as an intermediate.

A typical analysis shows the Hooker product to be 99.5% pure P_4O_{10}. No trioxide. No chlorine. Barely a trace of iron, lead, and fluorine. 11 ppm arsenic —hardly enough to write home about.

We use a lot of this compound to make our own phosphorus chemicals. We also get calls for it for use in pharmaceuticals, dyes, insecticides, and even as a catalyst. In the light of all this, would you like to send the coupon for a technical data sheet?

Looking for lauryl chloride that's a little bit better?

Would you like to work with a lauryl chloride that's clear and colorless and has a *minimum* of 16% chlorine?

Those are the specs on our special *high grade*. It's an oily liquid with the faintest of odors.

Analysis shows it to be a mixture of n-alkyl chlorides ranging from C_{10} through C_{14}. The C_{12} fraction predominates and accounts for about 80% of the compound.

For many purposes, of course, you'll find our *technical grade* every bit good enough. Its specs read about the same, except that the chlorine content drops to 15.5% and the product has a slight color—up to 2.5 ASTM, to be exact.

For data on both grades, send the coupon.

Caustic potash—custom package at standard price

Expose it to air and anhydrous caustic potash soaks up moisture and carbon dioxide until it becomes weak and slow-acting.

To help you avoid this and to protect the inherent purity of our Nialk® caustic potash, we make our own containers to our own carefully controlled specifications.

You can get this pure and well-protected compound in any of seven forms at 90% strength, or in flake and solid at 85%. If you prefer the liquid, we have that, too, in strengths from 45% to 52%.

Check the coupon for full details.

For more information, check here and mail with your name, title, company, and address.

☐ Phosphoric Anhydride ☐ Lauryl Chloride

☐ 1,2,4,5-Tetrachlorobenzene ☐ Caustic Potash

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411 FORTY-SEVENTH STREET, NIAGARA FALLS, N. Y.

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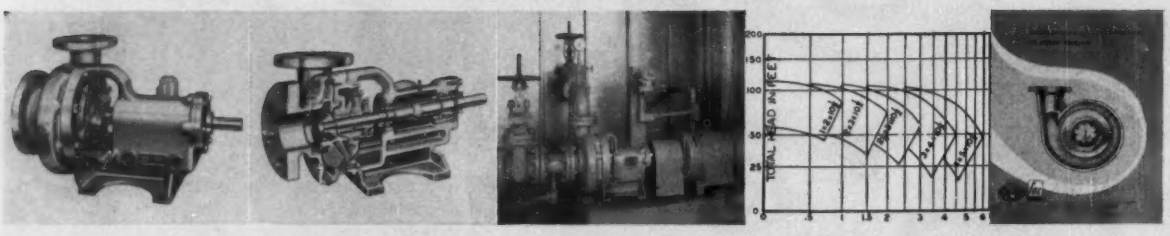
HOOKER CHEMICALS PLASTICS



BECAUSE...

PEERLESS CHEMICAL PUMPS:

MEET critical standards of construction, you benefit from longer pump life, less maintenance, and sharply reduced incidence of system shut down caused by pump failure. Top quality Peerless construction means a dependable, rugged pumping unit you can count on to stay on the job for years longer.

PROVIDE proved operating history, you benefit from the knowledge that you're not buying a pump in the dark. Analysis by Peerless of customer pump operating records allows continuous product improvement. Correlation of this data provides Peerless with answers to nearly all field pumping problems.

OFFER optimum performance range, you benefit from the economical performance only the exact pump for the job can give you. The Peerless process pump line of over 78 models, sizes and frames, plus thousands of combinations, assures you of pinpoint pump selection that effects direct savings in cost.

EMBODY benefits of research in all areas of design, construction, and application. Typical of the many considerations in the design and manufacture of a Peerless pump is the ascertaining of effects of radial loads. **An interesting 8 page booklet discussing this phase of pump design is available to you upon request.**

NOW WE CAN BE SURE!

Engineers and Pump buyers say:

...buy and apply PEERLESS PUMPS

Putting Ideas to Work

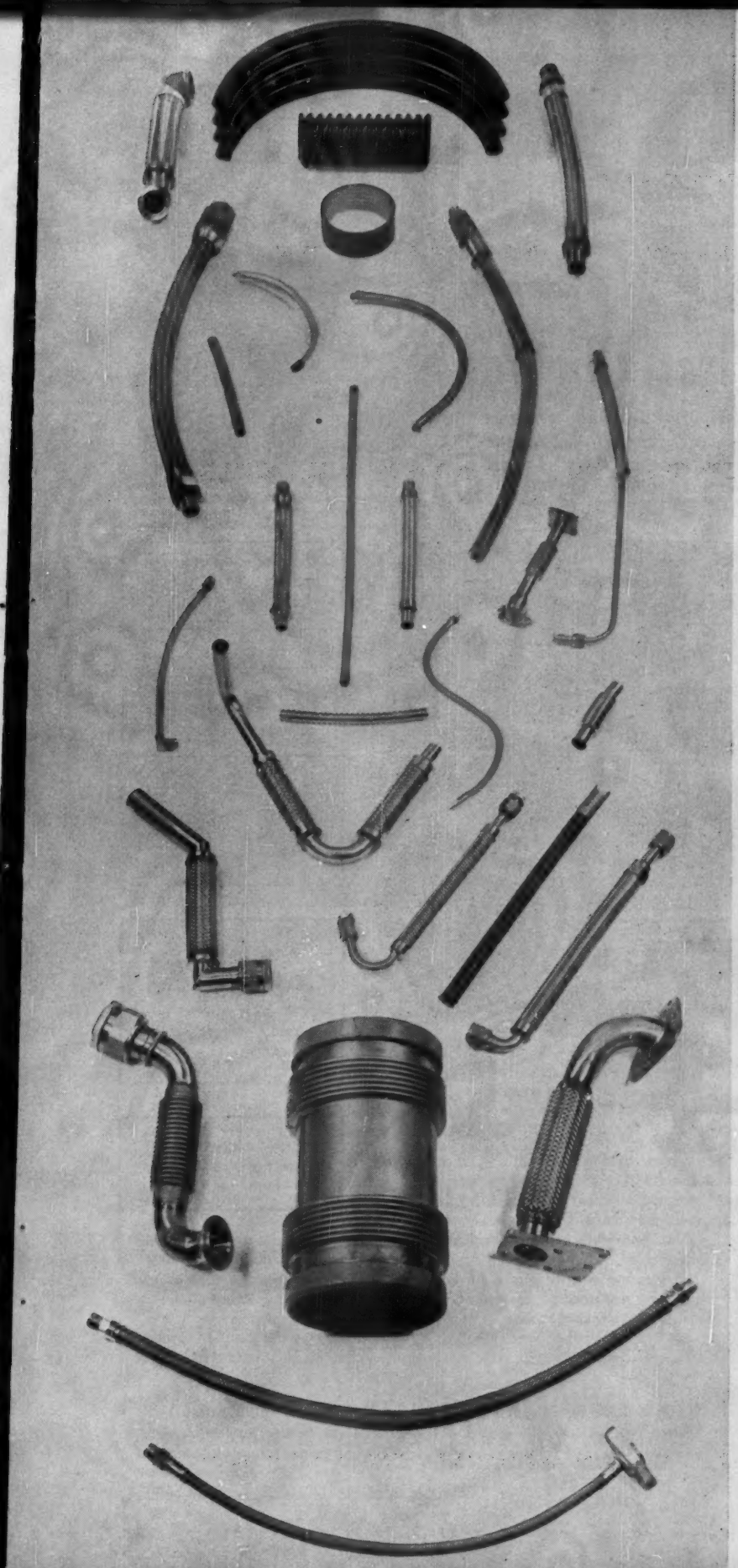
fmc FOOD MACHINERY AND CHEMICAL CORPORATION

Peerless Pump Division

Plants: LOS ANGELES 31, CALIFORNIA and INDIANAPOLIS 8, INDIANA

Offices: New York; Atlanta; St. Louis; Phoenix; San Francisco; Chicago; Fresno; Los Angeles; Plainview and Lubbock, Texas; Albuquerque.

Distributors in Principal Cities. Consult your telephone directory.



TELL US WHAT THE FLEXIBLE HOSE OR CONNECTOR MUST DO

Our engineers will send you design suggestions that can save you time and money.

Jet aircraft, modern chemical plants, rockets, atomic energy plants have created a new technology that calls for new products. The American Metal Hose Division of The American Brass Company is constantly working with design engineers on special flexible assemblies to meet new problems.

American is equipped to work in:

Copper alloys
Stainless steel
Other alloy steels
Monel
Aluminum
Teflon

Anaconda specialists welcome the opportunity to help you get the flexible metal hose assemblies you need to meet your problems of expansion and contraction, movement, vibration, corrosion, pressures, and temperatures.

FREE TECHNICAL SERVICE. For engineering assistance on special products—or for a free copy of our General Catalog showing the full line of standard American Flexible Hose and Tubing products—write: The American Metal Hose Division, The American Brass Company, Waterbury 20, Connecticut.

WHEREVER CONNECTORS MUST MOVE

AMERICAN

FLEXIBLE METAL HOSE AND TUBING

an

ANACONDA®

product

Made by The American Metal Hose Division, The American Brass Company

SPARKLER
horizontal plate
FILTERS

Undisputed First Choice

with engineers who have had occasion to thoroughly test this type of filter. Shown here are structural features that are the result of over 30 years experience in building this one filter. If it could be made better or cheaper Sparkler would have made it that way long ago.

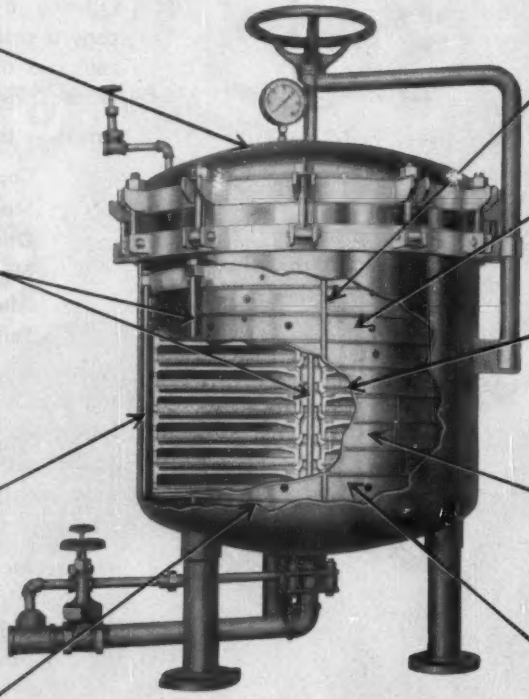
Aloysius C. Kracklauer
Originator of the Horizontal Plate Filter

A.S.M.E. designed construction is standard for pressures up to 60 lbs. on all filter tanks.

Plates sealed independently at center and periphery to assure positive seal.

Plates sealed independent of tank closure to secure a positive seal for both filter plates and for tank cover.

Scavenger plate supported by re-inforced flat bottom tank.



Cartridge plate assembly—removable independently of tank.

Heavy solid plate rings precision machined.

Heavy perforated sheet metal support for filter paper.

A more positive filter seal is obtained when hydraulic pressure is applied to plates externally rather than internally.

Plate designed to reduce flow friction to a minimum.

SPARKLER FILTERS

The Sparkler, original exclusive horizontal plate design and flow principle, has never been equalled for efficiency and dependability in filtering with any and all types of filter aids. The cake maintains its original position as formed regardless of pressure fluctuation flow rate or viscosity. No break-through is possible, even with a complete shut down of the filter. Filtering can be resumed with perfect safety at any time. With Sparkler plate construction a completely sanitary filter can be furnished.

SPARKLER MANUFACTURING CO. MUNDELEIN, ILLINOIS

Sparkler International Ltd.—Manufacturing plants in Canada, Holland, Italy and Australia.

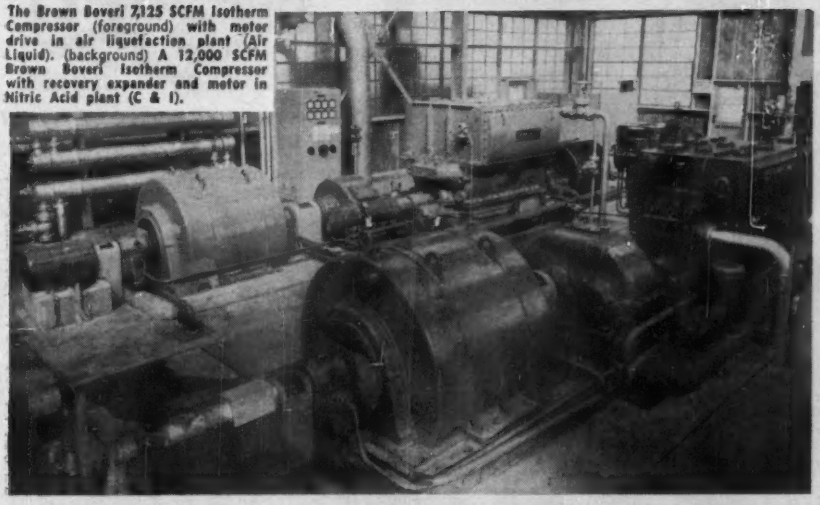
REPRESENTATIVES IN PRINCIPAL CITIES THROUGHOUT THE WORLD

for –

Large Volume*
Medium Pressure*

Oil-Free Air
at Lower Cost

The Brown Boveri 7,125 SCFM Isotherm Compressor (foreground) with motor drive in air liquefaction plant (Air Liquid). (background) A 12,000 SCFM Brown Boveri Isotherm Compressor with recovery expander and motor in Nitric Acid plant (C & I).



the

BROWN BOVERI ISOTHERM COMPRESSOR

WHERE large volumes of oil-free air (5,000 SCFM and up, 100-300 PSIA)* are required, there is no better equipment available today to achieve "close to isotherm" type of compression, assuring the lowest possible kW input, than a Brown Boveri Isotherm Compressor.

If "tail" gas is available, the high efficiency, reaction type Brown Boveri expander can be applied in the cycle with the Isotherm Compressor to improve further the economy of the process. As drive for the compressor a synchronous, induction or other type of motor, or a steam- or gas-turbine can be used.

Over half a century's background in the manufacture of this Brown Boveri equipment (including control and all accessories) is your positive assurance of the ultimate in the reliability of this "packaged" unit. Write for more information, *today!*

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BROWN BOVERI CORPORATION

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VISIT OUR BOOTH #556 AT THE POWER SHOW, N. Y. COLISEUM, DEC. 1-5, 1958

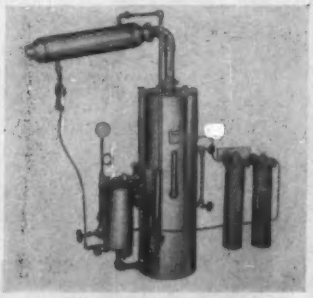
BARNSTEAD

PURE WATER SPECIALISTS SINCE 1878

WATER STILLS and DEMINERALIZERS

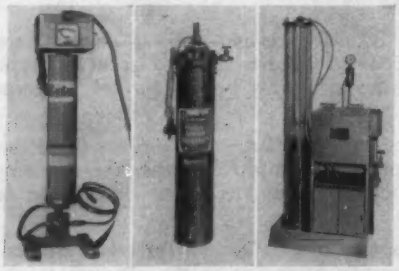
PUREST WATER AUTOMATICALLY

Barnstead Full Automatic Controls for water stills are self-starting . . . self-flushing . . . self-stopping. No human attention needed. Automatically guarantees a steady supply of distilled water of highest purity.



THE STILL YOU NEVER NEED CLEAN

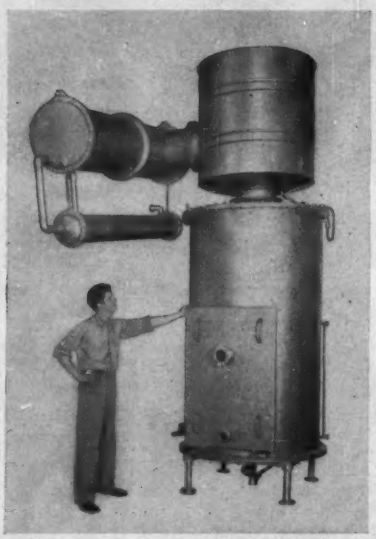
The NEW Barnstead Condensate Feedback Purifier for Barnstead Steam Heated Stills offers two important advantages. Produces distilled water of higher purity than ever before, and completely eliminates need for cleaning Still.



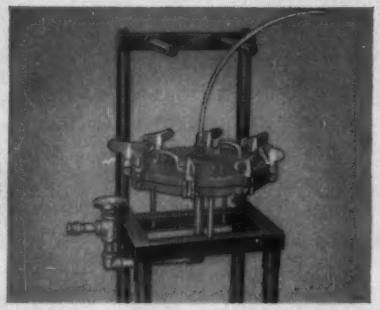
BANTAM DEMINERALIZER (BD-1) Connects directly to water supply. Disposable resin cartridge. Flow rate: 5 to 10 g.p.h.

PRESSURE BANTAM DEMINERALIZER (BD-2) Delivers demineralized water under pressure. 5 to 25 g.p.h. Pura-lite indicates cartridge change.

MIXED-BED DEMINERALIZERS (MM) in capacities ranging from 50 to 2500 g.p.h. Efficient and low cost in operation. Exceptionally high purity.

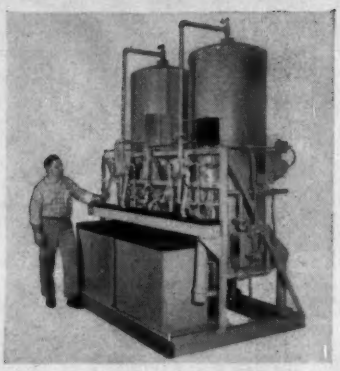


FOR PHARMACEUTICAL MANUFACTURERS. 300 G.P.H. PYROGEN-FREE WATER PRODUCED BY THIS MODEL SSQ-300 BARNSTEAD WATER STILL



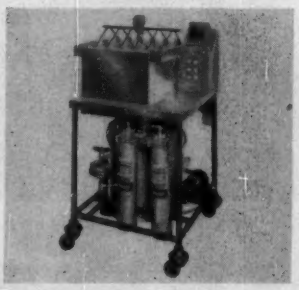
BARNSTEAD "MF" SUBMICRON FILTER FOR REMOVAL OF PARTICLES TO 0.45 MICRON

For either distilled or demineralized water . . . removes particulate matter which may cause trouble in some of the new processes in electronic and nuclear fields. Filters out particles as small as .000016 inches. Produces 15,000,000 ohm water in production quantities.



DEMINERALIZED WATER AT FLOW RATE OF 2500 G.P.H.

is produced by this Barnstead Model TM-6, Two-Bed Demineralizer. Complete package unit, factory assembled, ready to connect to raw water supply. Also Mixed-Bed, Single-Bed, Two-Bed, and Four-Bed Models. Write for catalog 127-A.



BARNSTEAD TRANSISTOR WASHER FOR WASHING TRANSISTORS, DIODES, RECTIFIERS, TUBE PARTS IN ULTRA PURE 15,000,000 OHM WATER

Faster rinsing and fewer rejects when hot, ultra-pure water is used in rinsing of electrical components. Barnstead Transistor Washer conserves thousands of gallons each day . . . as it repurifies the pure, hot water keeping it free of organic impurities and submicroscopic particles to 0.45 micron. Write for Bulletin #146.

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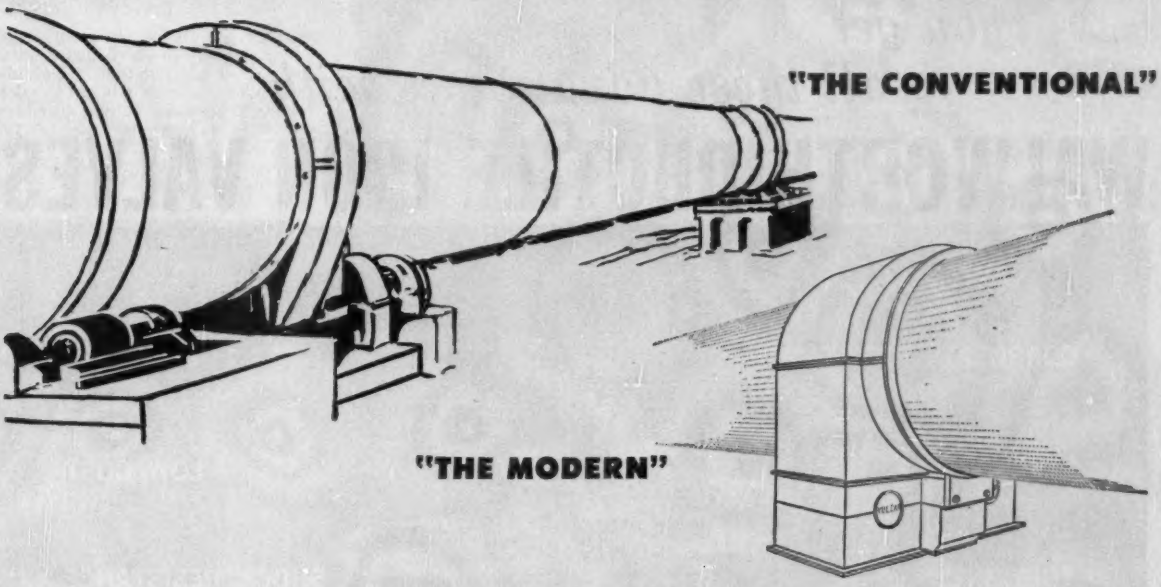
FIRST IN PURE WATER SINCE 1878

WHAT KIND OF A KILN DO YOU NEED?



VULCAN of WILKES-BARRE WILL DESIGN & MANUFACTURE ANY TYPE • FOR ANY APPLICATION

CEMENT (WET-DRY) . . . COKE . . . LIME . . .
CALCINED DOLOMITE . . . PIGMENTS . . .
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Plus Kilns for many other related chemical and metallurgical processes. VULCAN: the oldest name in Rotary Kilns, is ready to take care of your every need. Top-flight engineers are constantly searching for new developments in this field. This is reflected by recent patent applications evolving the "New Concept in Rotary Kilns". Always highest quality material fabricated in a modern plant by skilled craftsmen . . . Every department co-ordinated for fast follow-through.

VULCAN designs, engineers, and manufactures Rotary Kilns . . . and items listed below. If you need a Rotary Kiln that is unusual in size . . . type . . . application . . . contact the "kiln specialists" . . . Contact VULCAN of Wilkes-Barre. Write or call today. Estimates, constructive suggestions and preliminary drawings will be furnished (as far as possible) without obligation.

ANY INFORMATION ON ITEMS LISTED BELOW WILL BE SENT YOU IMMEDIATELY.

Rotary Kilns, Coolers • Improved Vertical Lime Kilns • Cast Steel Sheaves, Gears
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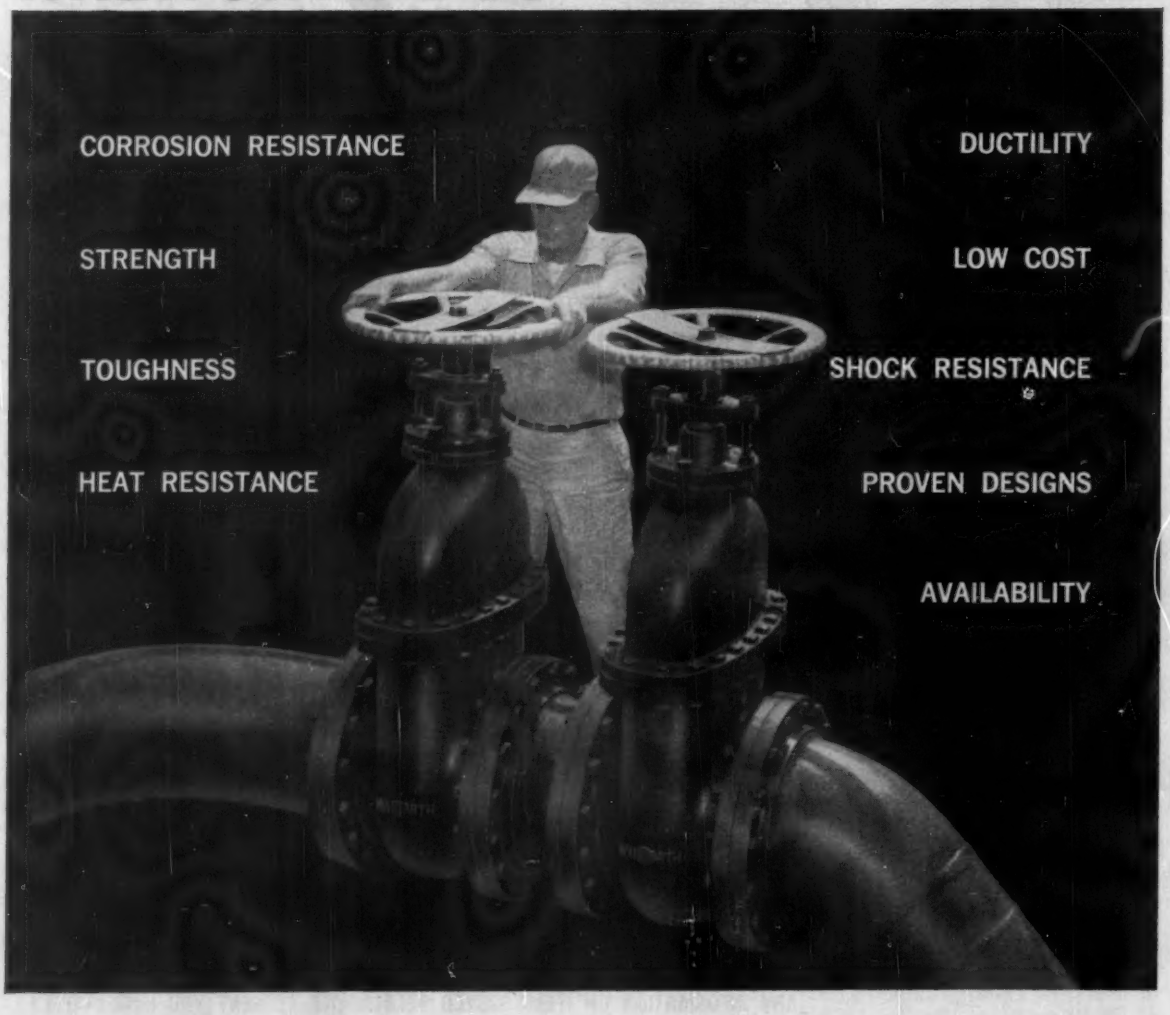
WILKES-BARRE PENNSYLVANIA

"THE OLDEST NAME IN ROTARY KILNS"

ESTABLISHED 1849 • CABLE ADDRESS: VULWORKS

In your plant piping systems you get all these advantages with

WALWORTH DUCTILE IRON VALVES



Walworth ductile iron valves give you – at low cost – corrosion resistance comparable to gray cast iron . . . strength approaching that of carbon steel . . . long life expectancy and minimum maintenance. Proven shock resistance . . . Walworth ductile iron valves have functioned satisfactorily after being heated to 1350°F and suddenly quenched.

When you buy Walworth ductile iron valves you get the benefit of Walworth's proven engineering and designs. Sizes ⅛ to 24 inches, screwed or flanged ends, OS&Y and NRS types.

For your copy of the new circular on ductile iron valves, contact your local Walworth distributor, or, write Walworth direct.

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"Bimetal Freeze-up" Can Be More Serious Than Dial Fogging Problem

The first sign of moisture in a dial thermometer usually shows up as condensation inside the dial glass. You are probably familiar with this dial fogging problem which causes difficult reading and the eventual corrosion of the bimetallic element. You may not, however, be familiar with another and actually more serious moisture problem —bimetal "freeze-up."

Both dial fogging and bimetal freeze-up are permanently prevented by RMC's dry air hermetic sealing process.

If moisture is sealed in, or enters a thermometer dial it will find its way to the bimetal element. Then at extreme low temperatures this moisture freezes on the element and bearing surfaces, and the bimetal element will not function should the temperature go lower. Therefore, the operator of the equipment would never know that the temperature had gone below the last indication when the element became frozen.

Here's what makes such a condition hard to spot. The thermometer would operate properly again after a temperature rise of perhaps 20°, and would continue accurate indication even though the fluid dropped again to an even lower temperature than before. However, after it remained at the new low for a few hours, it would again freeze up. Then, as before, any further drop in temperature would not be indicated.

Only a dry-air hermetic seal, as used by RMC, can prevent both dial fogging and bimetal freeze-up. RMC even goes a step further by providing for recalibration at any time without breaking the air-tight seal. An external dial reset screw—exclusive with RMC—permits recalibration without opening the instrument in any way.

Industrial Needs Call For Magnetic Liquid Level Gauge

Magnetic drive provides accurate readings with complete safety in all types of liquids under pressure. RMC Magnetic Level Gauges meet requirements of the Underwriters' Laboratories and A.S.M.E. Boiler Code.

Write, wire or phone—tell us your requirements for indicating instruments, and let RMC engineering skill provide the answers. Rochester Mfg. Co., 113 Rockwood St., Rochester 10, N. Y.

These RMC thermometers have just been submerged in water for 15 minutes—the first of a series of severe tests given RMC thermometers to make sure hermetic seal is perfect.

We make certain that moisture will never bother your RMC thermometer

The RMC hermetic sealing process makes absolutely certain that humid air will not be sealed in the instrument and locks all moisture out permanently. Each thermometer then goes through a series of severe tests. Only those with perfect sealing are accepted for delivery. When you order from RMC you get the *only* industrial thermometer that can *never* be affected by internal dial fogging or bimetal freeze-up.

RMC

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LIQUID LEVEL, TEMPERATURE and PRESSURE INSTRUMENTS

REPRESENTATIVES IN ALL PRINCIPAL CITIES

Type 304 stainless plate, dimensions: 6⅛" thick x 75" diameter. Weight, 8655 lbs.

take a look

...at the clean edges of this stainless plate accurately cut by Carlson

THIS stainless plate illustrates something that's almost a Carlson exclusive. Few producers can make plates of such heavy gauge, and fewer still have the long experience in flame cutting stainless to precise dimensions. To develop the proper equipment, the exact gas and iron powder formula, and the special nozzles, took Carlson engineers years of effort. But the result was worth it.

The edges achieved by these improvements reduce the cost of subsequent machining operations. And every Carlson stainless plate—whether heavy or light gauge—carries its own identification. Its chemical and physical properties are known and recorded. Its dependable performance on the job is assured.

The complete reliability of every Carlson service will materially reduce your ultimate costs. Our specialists make certain that your instructions are followed in every detail. Write, wire or phone for further information on all our services in stainless steel.

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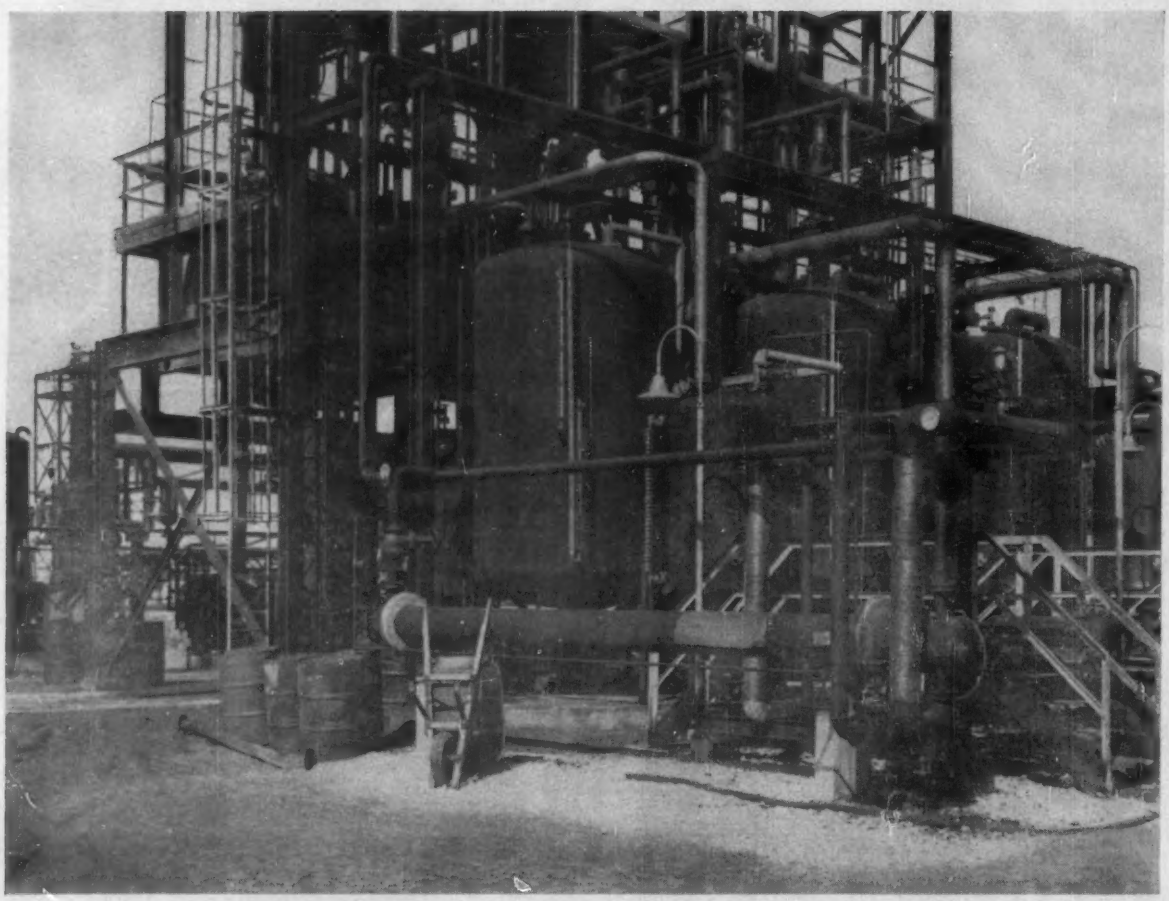


These three reactor tanks at Celanese Corporation of America, Point Pleasant, W. Va., are of Nickel-clad steel. They stand up well to corrosive chlorides.

Corrosive chlorides don't "put the bite" on these reactors

...*Reactors are made of Nickel-clad steel*

In making tricresyl phosphate for automotive and other uses, Celanese Corporation of America has its share of corrosion problems.

Although the final product is non-corrosive, the acidic raw materials and by-products could cause plenty of trouble for processing equipment if it were not adequately protected. The reactors, for example, are exposed to cresylic acid and phosphorus oxychloride. Storage tanks must handle hot crude tricresyl phosphate containing small amounts of hydrochloric acid.

In both places, Nickel-clad steel equipment is used not only to resist general corrosion, but also to prevent stress-corrosion cracking. Nickel and Monel* nickel-copper alloy are used at other points in Celanese's Point Pleasant, West Virginia plant where corrosion resistance is of prime importance.

Do you have a corrosion problem involving acid chlorides? Why not write for a copy of our Technical Bulletin T-29? It may suggest an answer.

*Registered trademark

The International Nickel Company, Inc.
67 Wall Street New York 5, N.Y.

INCO

Inorganic Acid Chlorides in which satisfactory use of Monel or Nickel is recorded

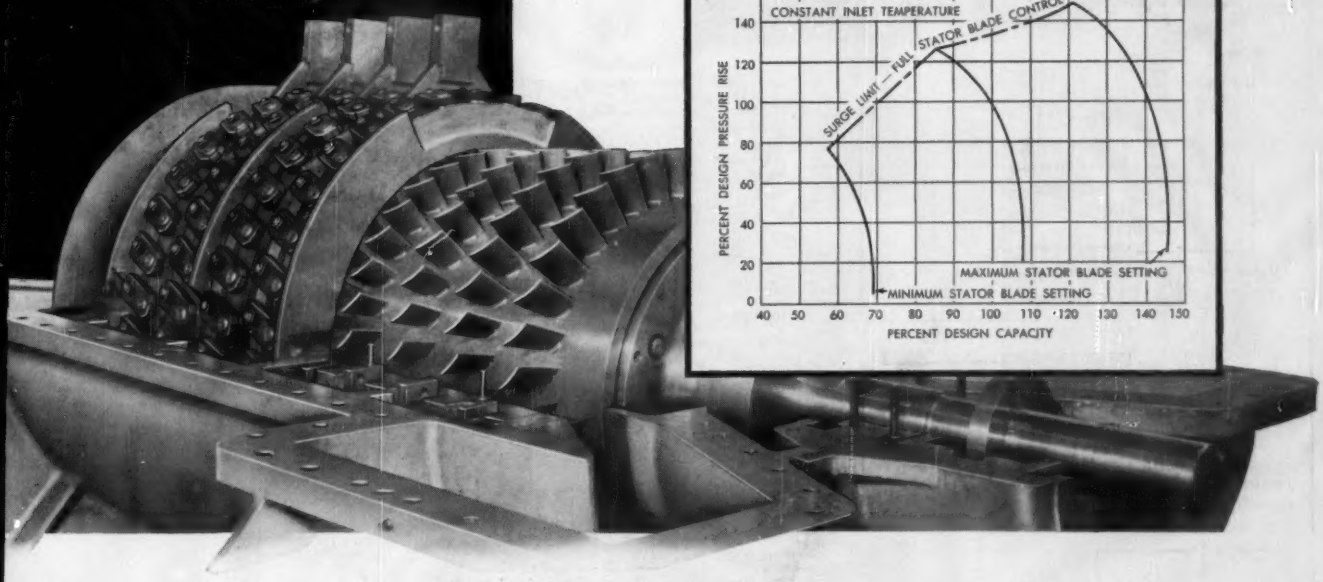
Corrosive Media	Monel	Nickel
Aluminum Chloride	Yes	—
Ammonium Chloride	Yes	Yes
Antimony Chloride	Yes	—
Arsenic Trichloride	Yes	Yes
Magnesium Chloride	Yes	Yes
Manganous Chloride	Yes	—
Nitrosyl Chloride	Yes	Yes
Phosphorus Oxychloride	—	Yes
Phosphorus Trichloride	—	Yes
Silicon Tetrachloride	—	Yes
Sulfur Monochloride	Yes	Yes
Sulfuryl Chloride	Yes	Yes
Tin Tetrachloride	Yes	—
Zinc Chloride	Yes	Yes

INCO NICKEL ALLOYS

Plan to stay ahead... MODERNIZE!

NEW

Adjustable Stator Blade Axial Compressors



Get wide capacity range at high efficiency

With adjustable stator blade control, now available on Allis-Chalmers axial compressors, varying capacity needs can be met by merely changing stator blade settings — while the machine is in operation. Limited operating range need no longer be a problem.

In fact, Allis-Chalmers axial compressors can now be used with almost the same capacity variation as the centrifugal, while maintaining the axial's characteristic high efficiency and pressure rise at part load points.

For details on the adjustable stator blade axial compressor, call your nearby A-C office, or write Allis-Chalmers, Industrial Equipment Division, Milwaukee 1, Wisconsin.

These additional advantages are inherent in axial compressor performance:

1. Because of the axial's wide range at constant speed, either steam turbine or motor drive can be used.
2. Small size, light weight of axial units cut space requirements, reduce foundation size and cost.
3. High compressor efficiency reduces horsepower required in driving an axial as much as 12%, compared with other compressor types.

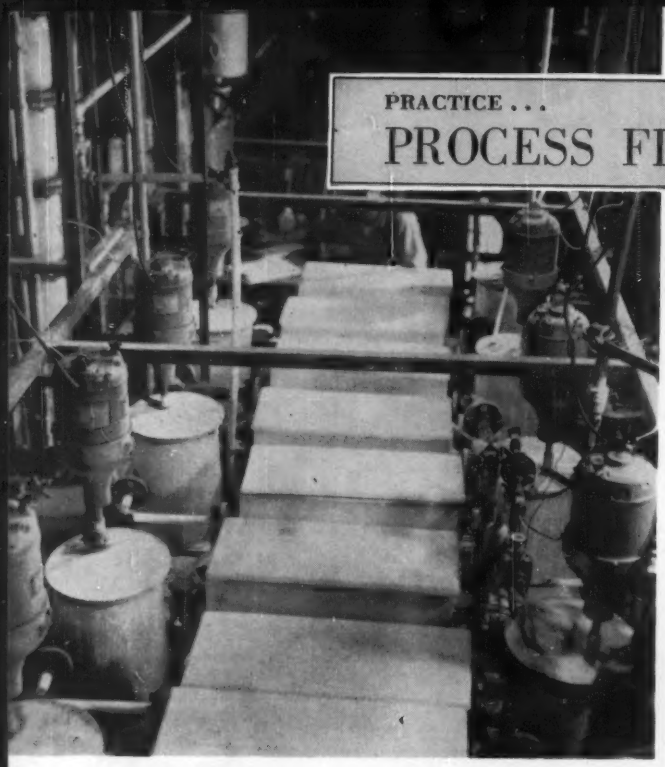
ALLIS-CHALMERS

A-5839

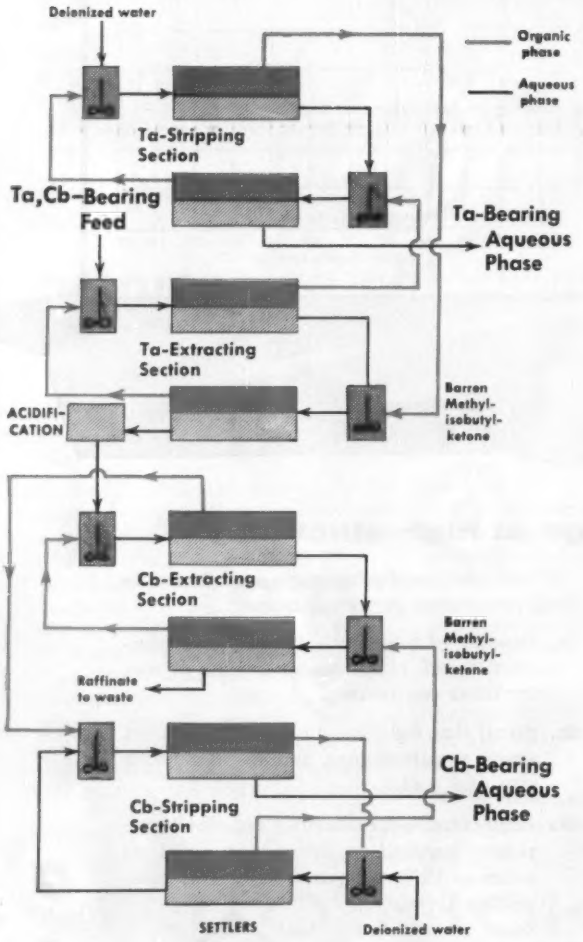
PRACTICE . . .

PROCESS FLOWSHEET

C. H. CHILTON



Liquid-liquid extraction carried out in this cascade of mixers and settlers leads to pure . . . . .



Columbium and Tantalum

Turning out columbium and tantalum for a 300,000-lb./yr. total market, Electro Metallurgical Co. (division of Union Carbide Corp.) is pioneering the use of liquid-liquid extraction as a tool for separating these metals on a commercial basis.

Process was piloted by the Bureau of Mines more than a decade ago. Several companies have since modified and developed it further (see p. 52).

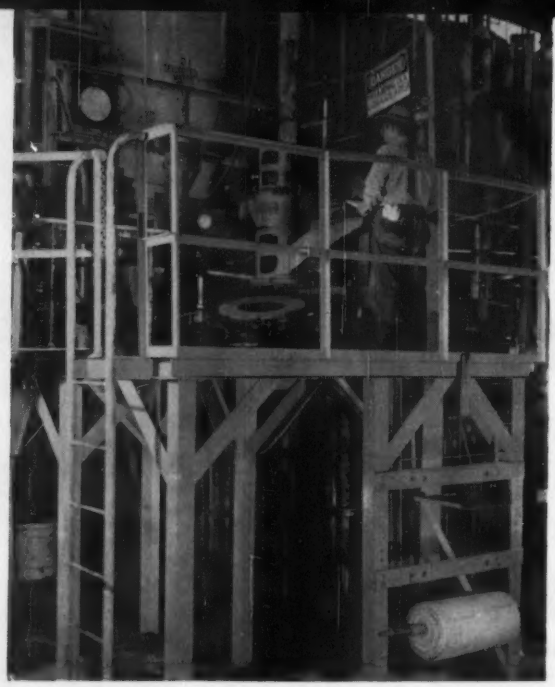
► **Metals of the Future**—Interest in these two metals is well founded on their important uses. Nuclear reactors and jet-propulsion devices make heaviest claims on columbium supply. Low neutron absorption, high thermal conductivity and corrosion resistance render columbium ideal for nuclear-fuel cladding and alloying. Columbium superalloys withstand temperatures over 1,900 F. that occur in rocket and missiles applications.

Tantalum is ideally suited for large-load capacitors; a thin surface film of oxide has excellent dielectric properties and the metal is extremely heat resistant. With a melting point of 5,432 F. it easily falls into the category of refractory materials. Too, it resists corrosion of all boiling acids except sulfuric, will stand up where other metals fail.

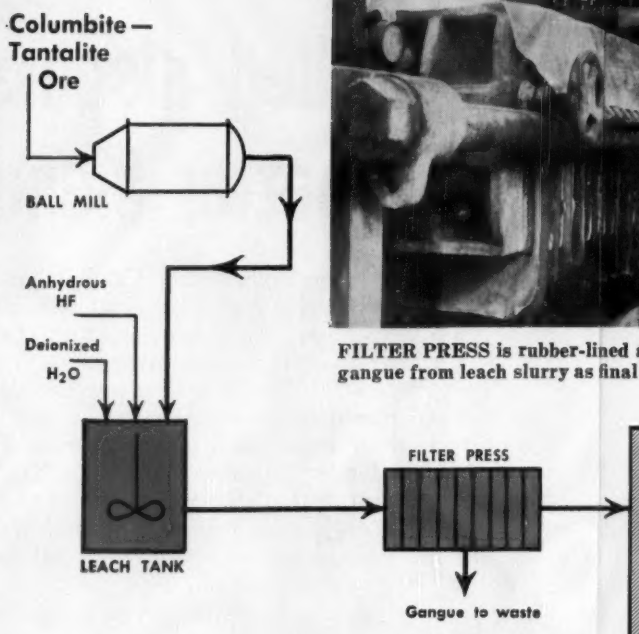
For such demanding applications these two metals must be super-pure. Slightest traces of oxygen, hydrogen, nitrogen, silicon, boron, iron or nickel disrupt the product picture. And, more than a tenth of a percent Ta in columbium and vice versa is untolerable.

► **Process Meets Challenge**—Electromet's process flow is geared to meet these stringent product-purity requirements. Relatively simple-to-control multistage

Unfold Flowsheet



LEACH TANK is constructed of wood and lined with Haveg. Here, HF leaches Cb and Ta oxides from ore.



FILTER PRESS is rubber-lined gangue from leach slurry as final

extraction step assures complete separation of Ta and Cb fluorides. The oxyfluorides are then precipitated from respective extract liquors, are filtered from slurries. Oxyfluorides are calcined to remove fluorine and reduced to metal with carbon in vacuum furnaces; latter step also removes last traces of gaseous impurities.

Where extraction was once carried out in columns, Electromet now carries out all stripping and extracting operations in its own specially designed cascade of mixers and settlers. Feed to cascade bears Ta and Cb as fluorides, is first mixed with methyl isobutyl ketone (MIBK) in the Ta-extraction section (see detailed diagram at left).

Ta-bearing organic phase goes to stripping section; here deionized water strips MIBK of Ta oxide. After its acidity is increased, Cb-bearing aqueous phase from Ta-extraction section feeds Cb-extraction section; at higher acidity, barren MIBK extracts Cb. Deionized water strips pure Cb from extract in Cb-stripping section.

Depleted MIBK from Ta and Cb-stripping sections feeds extraction stages, along with make-up solvent; aqueous raffinate from Cb-extraction section is discarded.

Each section of the cascade has more than one stage, but Electromet declines to say just how many stages there are.

▶**Process Flow**—Ball mill first grinds columbo-tantalite ore, containing approximately equal portions of Ta and Cb as oxides, to 100 mesh or smaller. Milled ore feeds 850-gal., Haveg-lined, wooden leach tank, where it meets anhydrous HF and water.

Resulting slurry digests for 10 hr. at 175 F.; Ta and Cb oxides dissolve. Bulk of impurities remains undissolved in gangue; small amounts of dissolved impurities are removed in following steps.

Gangue is filtered in a rubber-lined, Dynel-dressed, plate-and-frame filter press. By repulping and refiltering the cake, nearly every last ounce of dissolved Ta and Cb oxides is recovered from gangue; gangue is discarded.

▶**Ready for Extraction**—Resulting Ta-Cb-bearing liquor flows to rubber-lined holding tank for acidity adjustment and interim storage. From here it feeds the extraction cascade. Mixers are cylindrical polyethylene tanks equipped with rubber-covered paddle mixers; settlers are rectangular polyethylene tanks; no pumps are necessary since mixers provide adequate circulation.

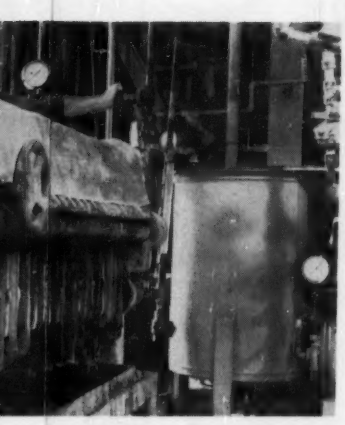
Two effluent streams from extraction cascade carry their respective Ta and Cb contents to 1,000-gal., rubber-lined precipitation tanks. Addition of ammonia raises the pH and results in the precipitation of Ta and Cb as oxyfluorides. Rubber-lined plate-and-frame filter presses remove oxyfluorides from slurry.

Oxyfluorides are dried and accumulated; Globar-heated furnaces calcine oxyfluorides to remove fluorine (in present operation fluorine is not recovered). Resulting oxides are mixed with carbon; induction-heated vacuum furnaces, operating at about 1 micron and over 2,000 C., reduce oxides to the metals. Products are respectively tantalum and columbium roundels (solidified cylinders).

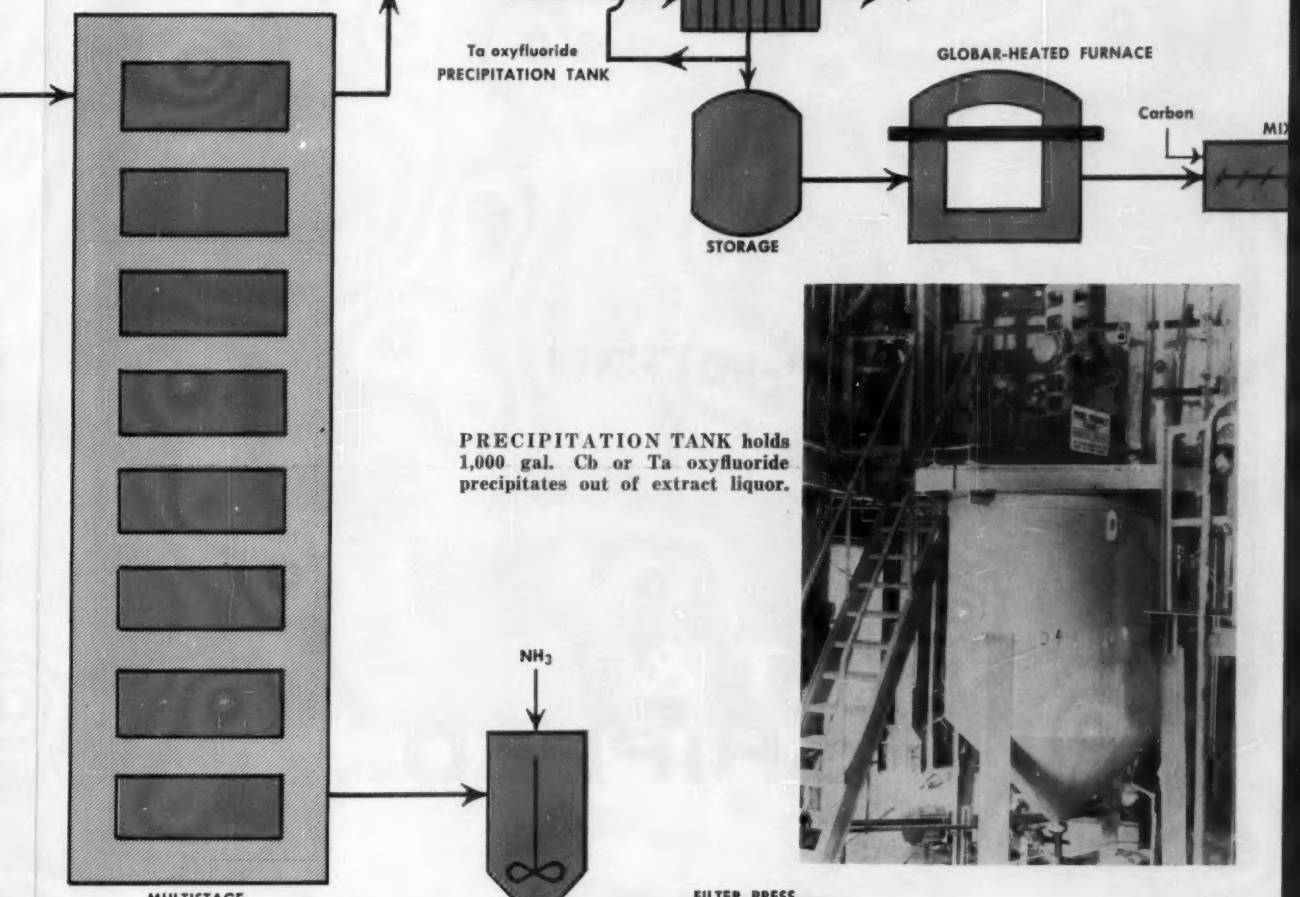
▶**Alternate Route to Ta**—Some users of tantalum prefer electrolytic dendrites over roundels; product forms have nearly identical purity, only physical form is different.

Ta-bearing stream from extraction cascade or Ta oxyfluoride from precipitation step feeds crystallization tank; HF and potassium fluoride or carbonate convert feed to potassium fluotantalate. Resulting slurry is centrifuged; salt is dried in tray dryer and fed to electrolytic cell. Cathode wins pure tantalum from salt; product is dendritic form. Fused salt may be reduced with sodium.

To meet the demands of some users, Electromet cold-compresses dendrites or roundels of columbium or tantalum into electrodes and arc-melts these into ingots.

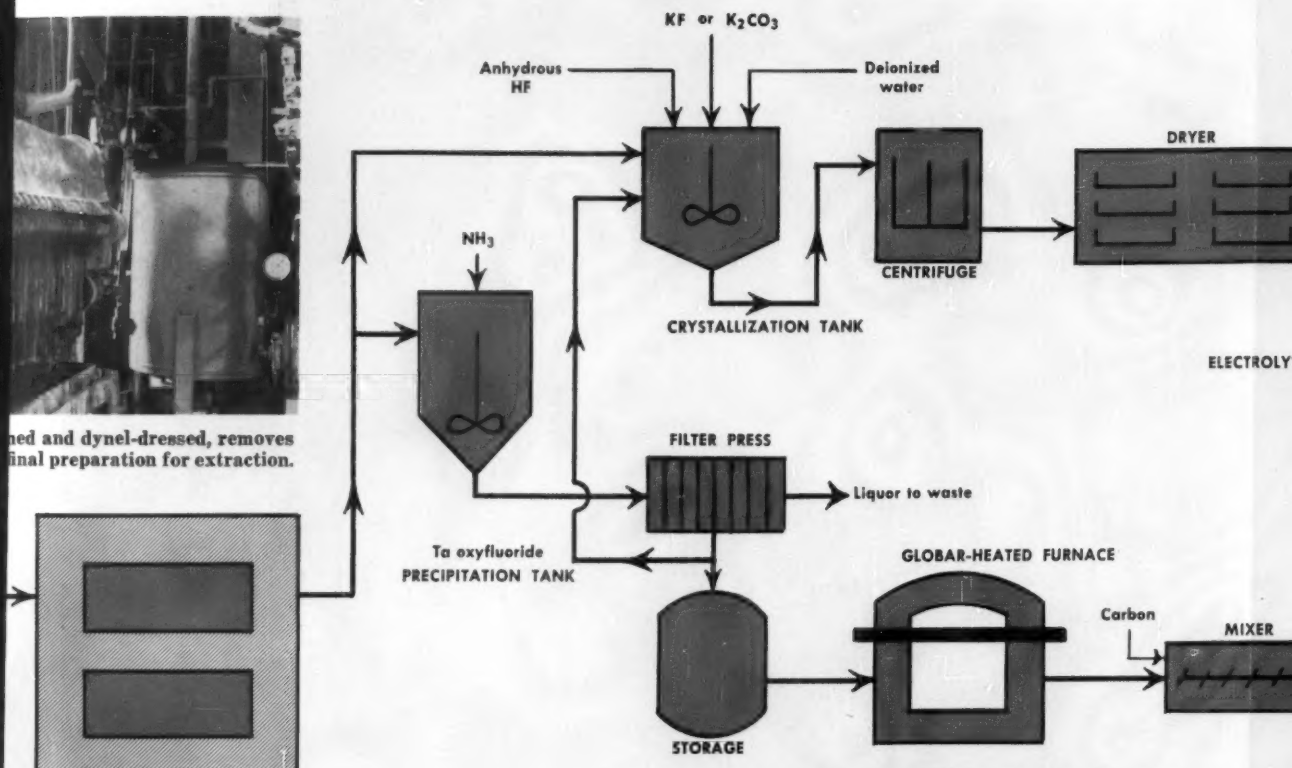


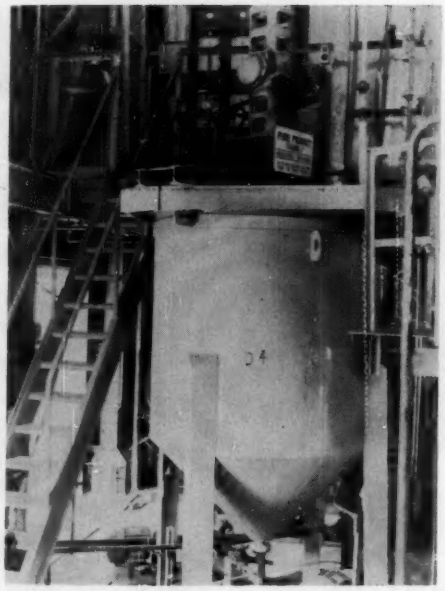
ber-lined and dynel-dressed, removes
ry as final preparation for extraction.



PRECIPITATION TANK holds 1,000 gal. Cb or Ta oxyfluoride precipitates out of extract liquor.

ned and dynel-dressed, removes
final preparation for extraction.





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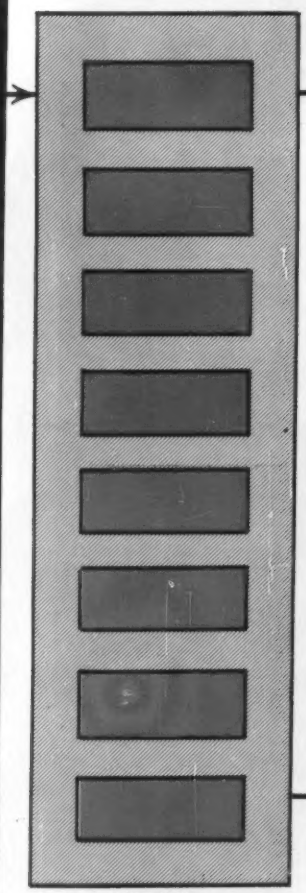
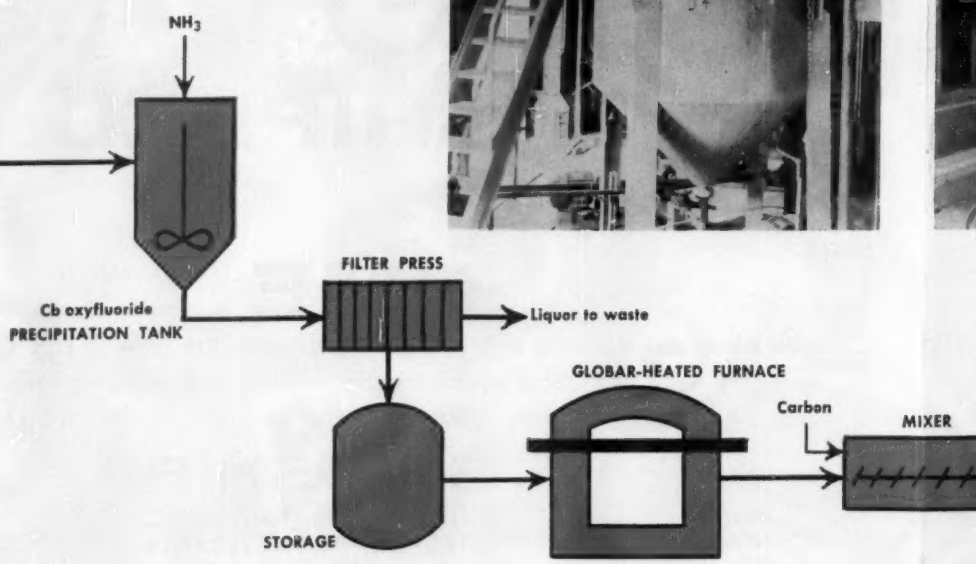
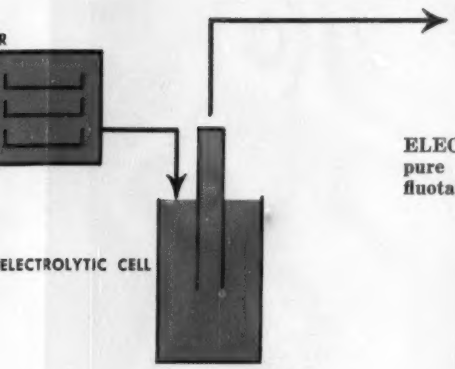
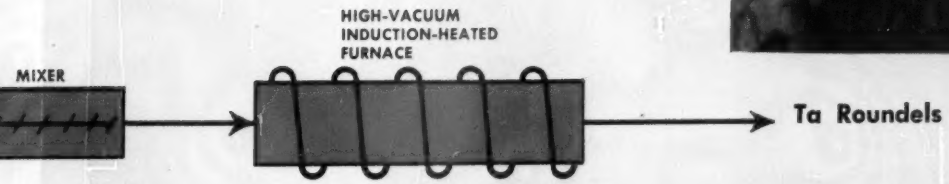


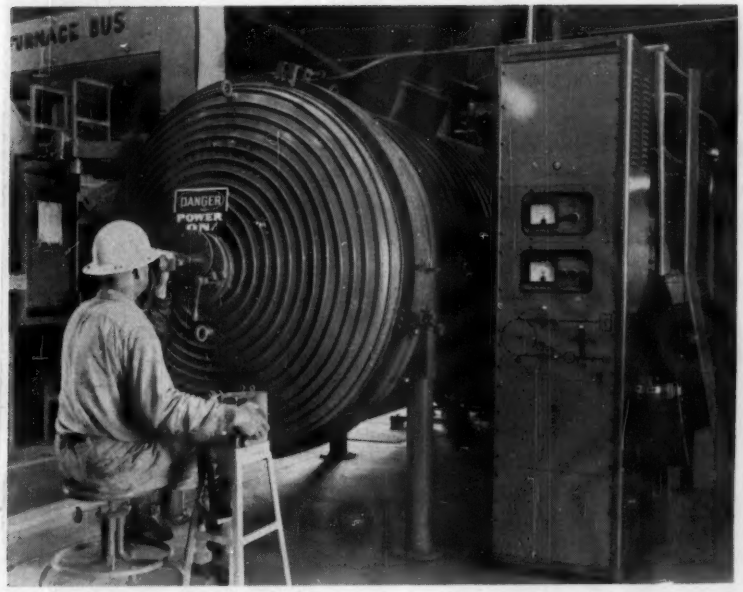
MULTISTAGE EXTRACTION CASCADE



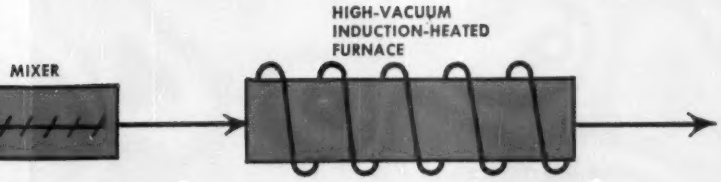


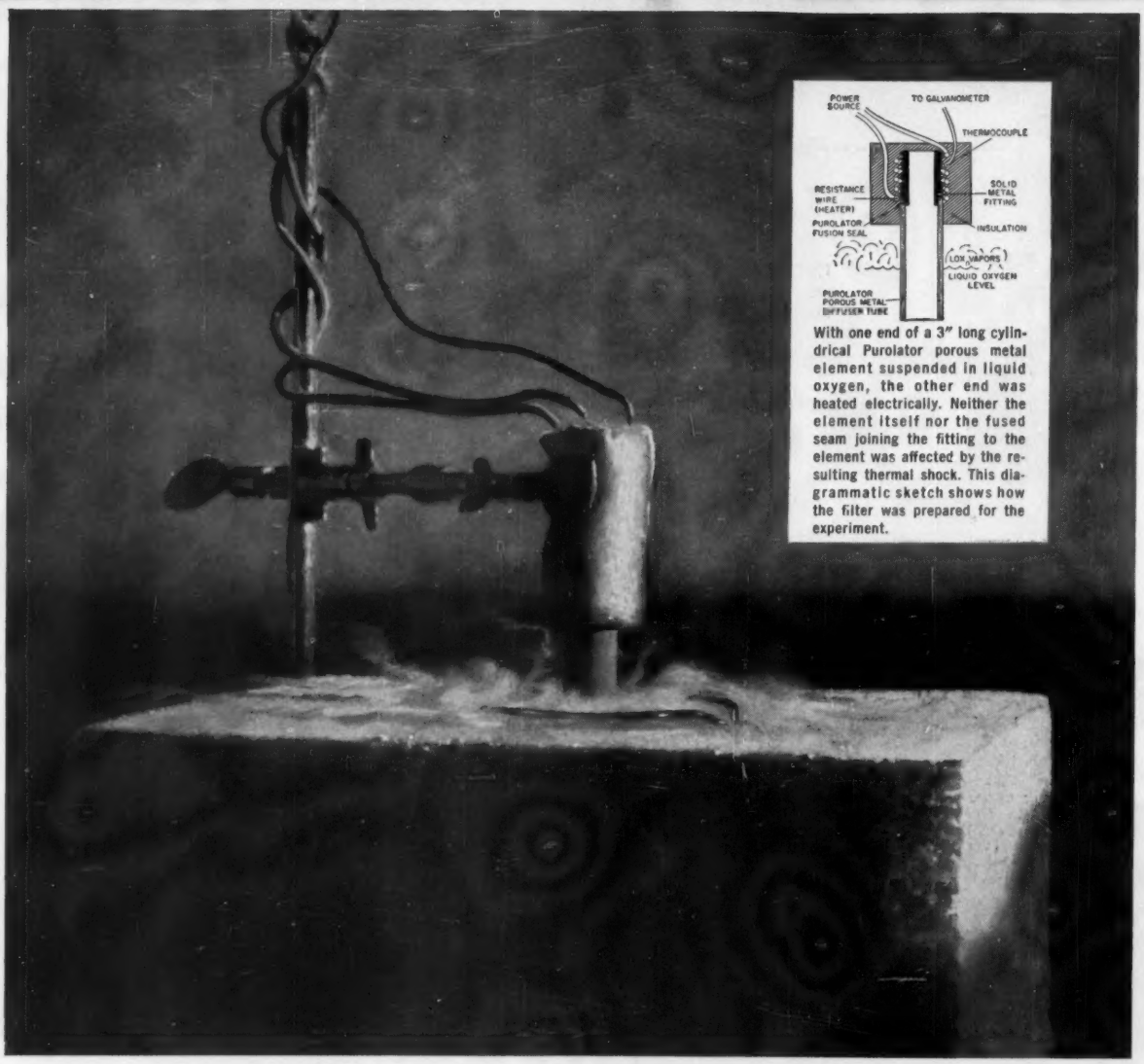
ELECTROLYTIC CELL wins pure tantalum metal from fluotantalate at its cathode.





VACUUM FURNACE is induction-heated, operates at 1 micron, over 2,000 C. to reduce oxide to metal.





With one end of a 3" long cylindrical Purolator porous metal element suspended in liquid oxygen, the other end was heated electrically. Neither the element itself nor the fused seam joining the fitting to the element was affected by the resulting thermal shock. This diagrammatic sketch shows how the filter was prepared for the experiment.

Filters for extreme conditions . . .

THERMAL SHOCK

Purolator metal filter media can take it

How much thermal shock can a filter withstand?

In a recent series of experiments, various samples of Purolator metal filter media stood up under temperature gradients, across short lengths, of up to 500°F...and could have taken more. There was no effect on filter efficiency.

Thermal shock is only one of the difficult operating problems Purolator's staff of "Q" and "L" cleared-filtration experts handle regularly. They can design and produce the exact filter needed to remove any known contaminant from any known fluid under any operating conditions. They have produced filters and separators to operate within the following wide ranges of conditions:

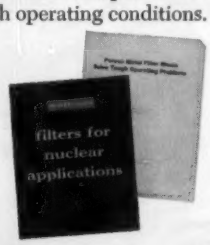
TEMPERATURES: from −420° to 1200°F.

PRESSURES: from a nearly perfect vacuum to 6,000 psi.

RATES OF FLOW: from drop by drop to thousands of GPM.

DEGREES OF FILTRATION: from submicronic to 700 microns (in various media).

No other filter manufacturer can offer such complete services to handle so wide a range of tough operating conditions. These brochures outline what Purolator can do for you, or, if you have an urgent filtration problem, call Jules Kovacs, Vice President in charge of Technical Sales... or send him the details of your application.

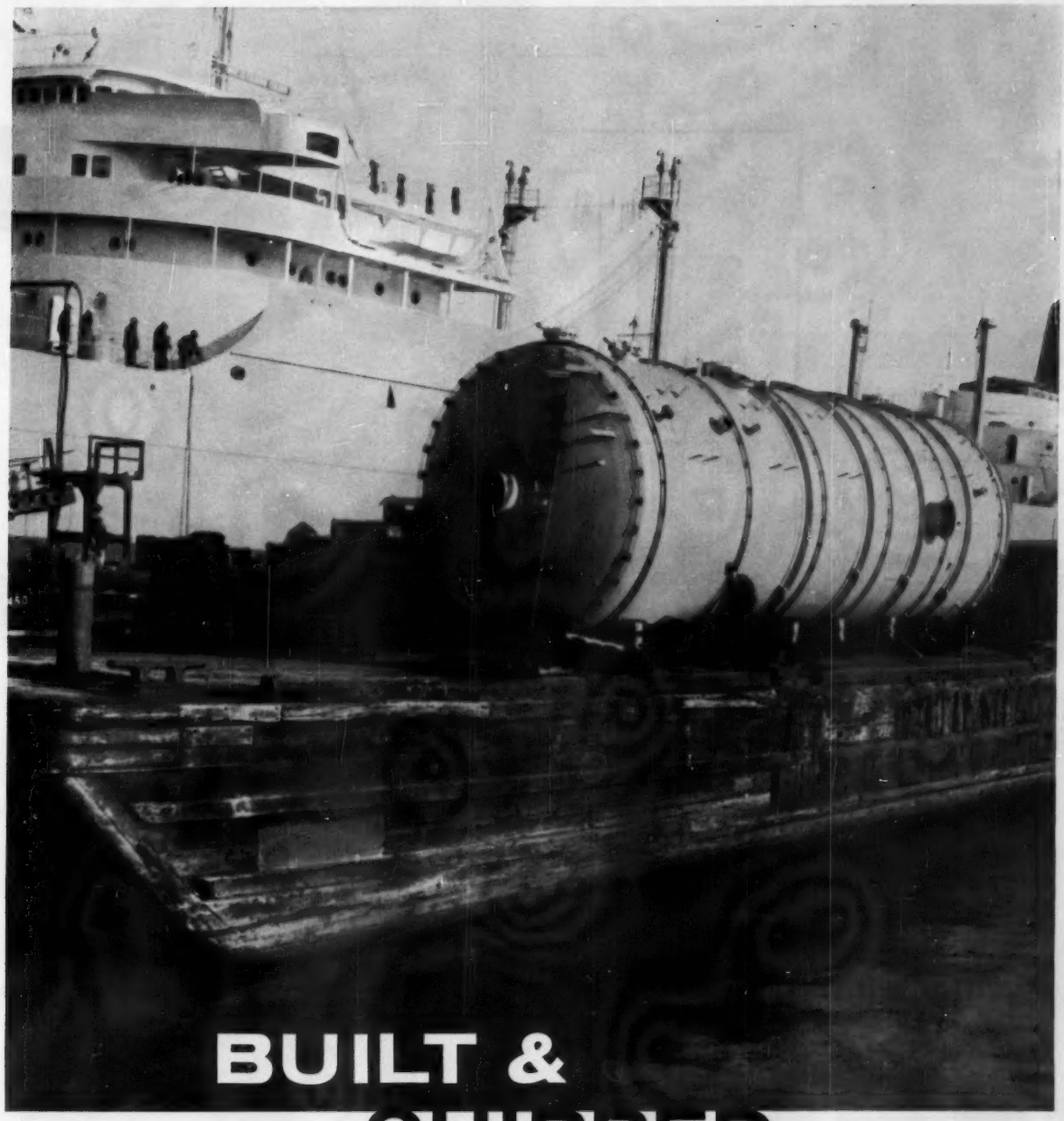


Filtration For Every Known Fluid

PUROLATOR

PRODUCTS, INC.

RAHWAY, NEW JERSEY AND TORONTO, ONTARIO, CANADA



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Today, modern oil refineries and chemical plants require more and more complicated pieces of fabricated equipment—too large to ship by rail or road. To meet this need, Sun Ship specializes in building and shipping large carbon or alloy steel units by water (inland, coastal or overseas)... directly from our plant.

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Controlled dispersion for better blends

If you're coating a fine, dry material; blending liquids into a dry powder . . . or dispersing a small amount of one material into another you need more than a simple stirring, tumbling or agitating action to achieve the desired results.

In the Simpson Mix-Muller a *three-way* kneading, smearing, spatulate action actually coats one material with another—rather than placing them *next* to each other. Agglomerates are broken up, moisture or binder dispersion is thorough. You get an intensive, homogenous mix that *stays* mixed and will not segregate in storage or transit. Want proof? Write for details on a confidential test. See what *mulling* can do and remember . . .

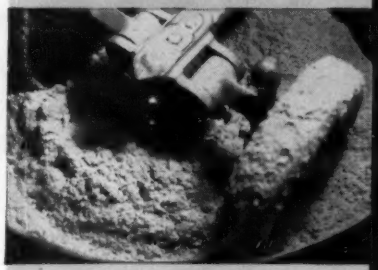
MIXING IS OUR BUSINESS

SIMPSON *MIX-MULLER*® DIVISION

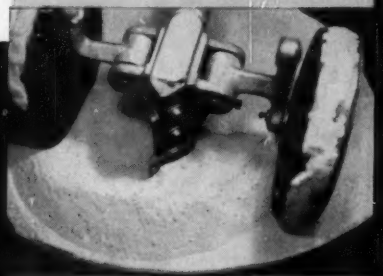
National Engineering Company
636 Machinery Hall Building • Chicago, Illinois

3 WAY ACTION saves time and reprocessing

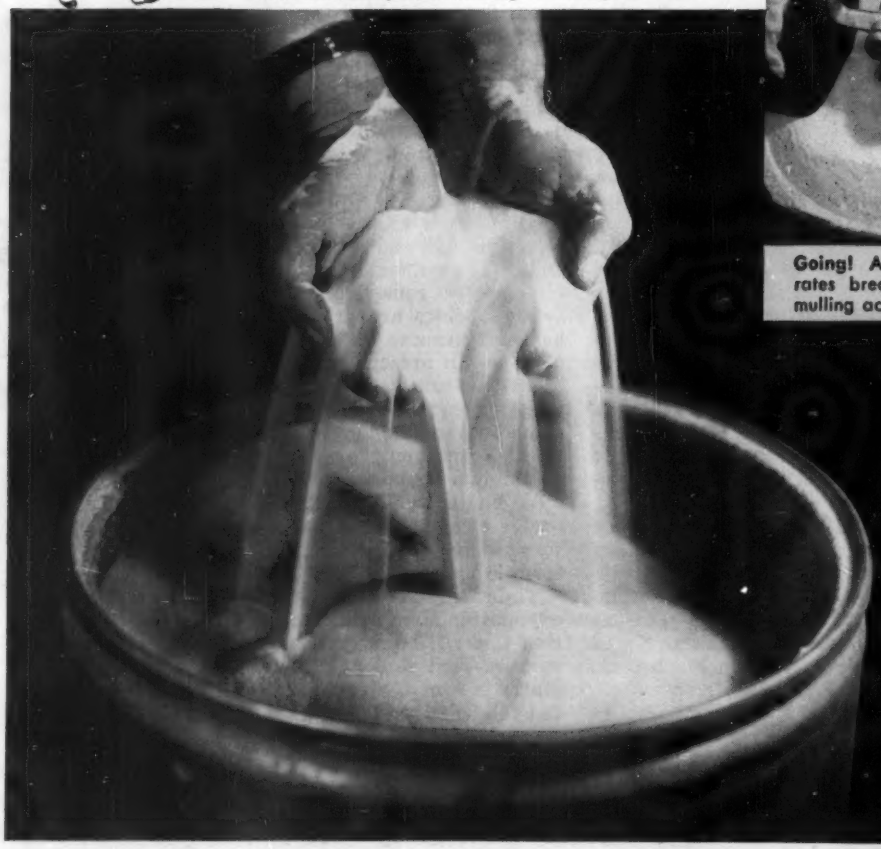
Mix is wetted; dispersion of coating media begins.



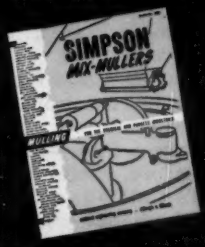
As mulling proceeds, mix begins to "lump" up as moisture is dissipated.



Going! As material drys agglomerates break down under intensive mulling action.



◀ Gone! Components are thoroughly blended. Mix is uniform, smooth flowing . . . quickly achieved.



WRITE FOR Bulletin on *Mulling for the Chemical and Process Industry.*

Chemical Engineering

Practice

NOV. 3, 1958

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Bureau of Mines process finds application in the production of two more strategic metals. MIBK extraction replaces customary fractional crystallization.

Special report on CPI modernization in '59.....113-144

Unique and exclusive survey measures America's needs for modernization. Now we know how big this priority job really is if we are to get costs down in the years ahead. (p. 113)

We've assembled the experts—a baker's dozen of them—to tell you how to determine if your plant needs modernizing, and why it's important to do it now. (p. 117)

When up-dating chemical process industry operations, the team approach can be very useful in locating areas that have become antiquated and old-fashioned. (p. 128)

For your plant modernization program, our engineering practice editors summarize new equipment developments in 16 important chemical engineering operations. (p. 131)

What are the benefits of modernization? Five large processing companies give some concrete answers to this question in terms of their own recent experience. (p. 139)

Why you should write in the first person..... 147

It's no longer a question of style or preference. Today, for the sake of accuracy in this age of contract research, you must use the first person in technical writing.

Novel plastic metals save corroded equipment..... 150

Costly shutdowns can be minimized by repairing corroded, damaged chemical equipment using new techniques based on metal-filled, putty-like plastics.

KING SIZE

This giant 37 ton Cat Poly Reactor is one of 4 units shipped to a large petroleum refinery in the State of Washington. It is 4'-3½" in diameter by 32'-0" long and has a 1³⁄₁₆" thick shell. Each of its 8" thick heads is attached to the shell channel with 28 special alloy stud bolts 2¾" diameter by 15¼" long having nuts 4¼" across the flats. Into the 5¾" thick tube sheets 190 tubes, 2½" O. D., No. 5 gauge and 30'-0" long, are rolled and seal welded. Designed for 1,230 lbs. pressure on the tube side, the reactor was completely X-rayed and stress relieved.

Vogt, a leading builder of shell and tube reactors for poly plants, has the competently skilled personnel and modern mechanical facilities with which to provide heat transfer equipment for the most exacting services in petroleum refineries, chemical plants, and related industries.

Reactors ...by Vogt

A bulletin describing the wide range of heat transfer equipment built by Vogt is available upon request.

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HENRY VOGT MACHINE CO., LOUISVILLE, KENTUCKY

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Chemical Engineering
NOVEMBER 3, 1958

PLAN '59

How Modern Is American Industry?

Survey finds $95 billion needed to replace obsolete facilities. Modernization is 1959's greatest opportunity and challenge.

The Modernization Job Ahead:

The McGraw-Hill Department of Economics asked a wide sample of manufacturing companies, and experts in other industries, "What would be the cost to replace all obsolete facilities with the best new plant and equipment?" Here is a summary of the estimates. (Details on next page.)

Manufacturing and mining	$34.3 Billion
Petroleum industry	5.3
Transportation and communications	18.4
Electric and gas utilities	12.0
Finance, trade and services	25.0
Total: All business	$95.0 Billion

McGRAW-HILL DEPARTMENT OF ECONOMICS

THE U.S.A. is starting a new period of economic growth, as we leave behind the recession of 1958. This new period presents a challenge to the nation, to the business community and above all to the individual company—to grow at a profit.

By now it is clear that growth is the normal way of life for the U.S. economy. Since 1947, our national product has been growing at a rate of 3.7% a year. And no recession, even the latest and most publicized, has interrupted the trend for long. Now the economy is growing again.

But the conditions of growth are far different from those that prevailed in the years 1947 to 1957.

Today growth in the economy does not mean pressure on capacity, for most industrial firms. It does not mean easy profits. Rather, this is growth under highly competitive conditions, with profits dependent on a firm's ability to hold down costs. Is our plant and equipment modern enough to do the job?

To find the answers to this question, the McGraw-Hill Department of Economics has just completed a special survey of the needs of U.S. business for modernization.

The survey shows it would cost $95 billion to replace today's obsolete equipment. And this is a priority job, if business is to get costs down for the years ahead.

This tremendous need for modernization presents a challenge to the U.S.A. as a nation. The Communist powers are making a strong and disciplined effort to demonstrate that they can out-produce us—that they can "plow us under" in a contest of industrial strength.

It is a challenge to American business. Our people expect a continuously rising standard of living. Our workers expect wage increases. And often their demands mean price inflation—unless we can achieve sharp gains in output. The public demands higher national income without inflation. This is the challenge to business as a whole.

It is a challenge to the individual firm. Growth in the economy no longer means

PLAN '59

McGraw-Hill Survey of Modernization Needs

McGraw-Hill Department of Economics, Aug. 1958

	Percent of Manufacturing Capacity Installed			Cost to Replace Obsolete Facilities, Millions of $
	Prior to Dec. '45	Dec. '45 to Dec. '50	Dec. '50 to Dec. '57	
Iron and steel	47%	16%	37%	2,855
Nonferrous metals	47	13	40	1,022
Machinery	41	21	38	3,224
Electrical machinery	34	18	48	1,917
Autos, trucks and parts	42	11	47	2,204
Transportation equipment (aircraft, ships, railroads)	59	9	32	854
Other metalworking	54	17	29	2,351
Chemicals	30	23	47	3,070
Paper and pulp	49	17	34	2,655
Rubber	46	9	45	600
Stone, clay and glass	46	20	34	1,840
Petroleum refining	45	26	29	1,499
Food and beverages	58	19	23	3,443
Textiles	59	18	23	1,001
Misc. manufacturing	51	21	28	6,236
All manufacturing*	48	19	33	34,771

*Includes petroleum refinery companies listed under "petroleum industry" in previous table.

an automatic rise in sales and profits for any particular company. There are no shortages; industrial capacity is ample. So to participate in growth, the individual firm must achieve better quality or lower costs than its competitors. Otherwise, there will be no profit in growth and no success story for the company.

Is business prepared today for these challenges? The answer, from our study, is clearly "No". The production and distribution facilities of the U.S.A. are not efficient enough to ensure our continuing superiority over the Communist world, to match every wage increase with higher productivity, to do business in a competitive economy at satisfactory profit to the individual firm.

This statement sounds shocking at a time when much industrial capacity is idle and the recession just behind us is being blamed on a surplus of capital goods. But the facts speak for themselves. Here is the record on the past decade of investment in new plant and equipment, and here is our new study of the job that still remains to be done.

Decade of Expansion*

Since 1947, private business in the U.S.A. has invested $291 billion in new plant and equipment. Our manufacturing capacity has increased about 80%; electric power capacity, 145%; capacity for basic raw materials, by 55%. The distribution and service industries have increased floor space by roughly 50% in the decade. In 1957 alone, business spent $37 billion on new plants and equipment—more than the combined expenditure in all of Western Europe plus Canada.

But all of this expenditure has not made our facilities as modern as supposed, or as modern as we need. Of the $291 billion invested by business since 1947, roughly $157 billion has been for expansion of capacity. Only $134 billion has been spent to replace old facilities with better, more modern equipment. And in recent years, this investment has not purchased as much new equipment as the dollar figures suggest, because prices of capital goods have climbed.

*Figures on "Decade of Expansion" are for the years 1947-1957 inclusive, except where specific reference is made to preliminary data for 1958.

Our postwar capital investment has repaired the worst of the obsolescence accumulated during the depression and war years. But huge amounts of old equipment are still in use, as shown by the table (left). This is based on a survey of the age of manufacturing capacity in several hundred companies, representing all of the major manufacturing industries. Almost 50% of our present capacity was installed before or during World War II. More than 65% was installed before Korea. Expert studies of the major non-manufacturing industries show that the age of equipment, in those industries, is even greater.

Thus, of all business plant and equipment, less than one-third is modern in the sense of "new" since 1950; two-thirds is pre-Korea.

This over-all figure is confirmed by a check on specific industries:

- Nearly two-thirds of our metal-working equipment was installed over 10 years ago, according to preliminary results of *American Machinist's* 1958 census.
- Over 65% of the freight cars on our railroads are more than 10 years old.
- Less than half the capacity to process chemicals, rubber or petroleum is new since 1950—a period that has seen rapid development in such equipment as automatic controls for these process industries.

These examples take on a dollars-and-cents meaning when we recognize that the latest machine tools are about 40% more productive than 1948 models, and that a combination of new freight cars and modern freight yard equipment can reduce operating costs up to 50%. New instruments, that automatically direct the flow of a chemical (or other raw material) process, can often reduce processing costs enough to pay back the cost of the instruments in one year. These savings cannot be made in older plants. By using obsolete facilities, our industries accept a waste in labor and materials that totals many billions of dollars per year.

Why Productivity Must Rise

The U.S.A. can ill afford this waste. In the economic struggle be-

tween the free world and Communist world, our margin of superiority depends on the efficiency of our productive facilities.

For the growth of our own economy, we shall need a sharp rise in productive efficiency. During the next ten years, American business must provide the goods and services required for a population that will increase by 32 million. And the increased population will expect higher living standards. Furthermore, the population in ten years will include a higher proportion of dependent persons—children and retired people—and a smaller proportion of working age men. Thus, with a relatively smaller labor force, industry must provide more goods for more consumers.

At the same time, industry must strive to hold the line against rising costs. In an economy with a tight labor supply, we cannot count on restraint in wage demands, however desirable such a development might be. In the past ten years, hourly wage rates have increased over 5% per year, nearly twice as fast as output per manhour. And this disparity may well continue—causing still more inflation—unless we make more rapid gains in productivity.

We can make these rapid gains—if industry goes all out to modernize its equipment. Output per manhour (in manufacturing) has increased only 2.5% per year since 1951. But this compares with gains of 4% a year in 1947-1950, and over 5% in the 1920s. Today the machines and techniques are available for us to equal, or exceed, these records—to raise output per manhour at least 5% per year. This is a job that can, and indeed must be done, to assure growth in the economy without inflation.

The Job Ahead

The dimensions of this opportunity are shown by the table on the previous page. In its survey on the need for modernization, the McGraw-Hill Department of Economics asked a wide sample of manufacturing companies how much it would cost to replace all their out-dated facilities with the best new equipment available. The Department also interviewed experts in each of the non-manufacturing industries, to find answers to this question. The answers add up to a staggering bill for new plant and equipment.

Modernization of over-age facilities—replacing only what is really obsolete, by today's production standards—would require a total capital investment of $95 billion, or nearly $20 billion per year for the next 5 years.

Furthermore, new production techniques will soon make today's plants obsolete, in many cases. Thus, to keep pace with technical advance from 1958 on, will require continuing expenditures of $8 to $10 billion per year for modernization.*

The total expenditure to wipe out the backlog of obsolete facilities, and keep up with continuing technical advance between now and 1963, would be at least $135 billion.

The U.S.A. has never spent such a sum on the modernization of industrial facilities, Capital expenditures of boom dimension have, in the past, been associated only with the urgent expansion of capacity. Some forecasters are now saying that because industrial capacity is adequate, the next few years will be a period of low capital investment. The figures above make clear that this would be a national calamity. The opportunity is there—and the challenge—to invest record amounts of capital in the modernization of plant and equipment.

A National Problem

This also is a challenge to the U.S.A. as a nation. For 100 years, this nation has been looked to as the model of economic development by the rest of the world. For the first time, we face a serious challenge by another nation and another economic system that claims to be better.

In a carefully documented 111-page study released in May,† the U. S. State Department declared that "the most serious threat" to the U.S.A. today is the drive for economic supremacy by the Soviet Union. Although a much smaller nation industrially than the U.S.A., the U.S.S.R. is today increasing its national output at a rate of 7% per year and its output per manhour by 4% per year.

The U.S.A. does not have to match these specific figures, which represent the results of forced labor in a country just starting to develop industrially. In the contest to win uncommitted nations, the statistics are not likely to be quoted exactly, in any case. But our over-all growth in national output and living standards must be so impressive as to leave no question of superiority. Our factories must be showplaces of modernization to the foreign visitor that will leave him unable to say "I saw much better" in Britain, or West Germany, or Russia.

This is the challenge to the nation—a political challenge to be sure. But it coincides with the challenge to the business community and the individual firm. And the way to meet it is the same: by thorough and rapid modernization of our plant and equipment—not by the slow and steady pace of recent years, but at an accelerated rate that reflects the greater pressure for output at lower cost.

Obstacles To Be Overcome

We must face up to the fact that real obstacles—both technical and financial—stand in the way of faster modernization. Some companies do not have the technical "know-how" required for the latest production techniques. Many more lack the financial resources. How can we overcome such obstacles, and speed up the replacement of old facilities?

In the course of its study, the Department of Economics obtained comments on these questions from many executives. One of the problems, as we noted above, has been the urgent pressure to expand capacity during most of the postwar period. In giving their attention to this problem, companies have sometimes overlooked the chance to modernize older plants.

In some cases, equipment has been kept in place because it was satisfactory, and the users were not aware of still newer designs. Some equipment users believe that equipment makers are not sufficiently ag-

*This estimate is based on technical developments reported by McGraw-Hill editors and current price trends for capital goods. It is consistent with the plans for modernization expenditures in 1958-61 reported by companies in a McGraw-Hill survey conducted in April, 1958.

†"The Sino-Soviet Economic Offensive in the Less Developed Countries"—U.S. Department of State, May, 1958.

PLAN '59

How Soon Does Modernization Pay Off?

Profits on modernization—like all business profits—have come down since 1955. However, modernization, in contrast to new capacity, still offers a relatively quick return on investment. Here are companies' answers to the question: "In cases where you are actually replacing old facilities with new plant and equipment in 1958—how soon do you expect these replacement expenditures to pay off?"

	The Way the Companies Answered			
	1–2 Yr.	3–5 Yr.	6–8 Yr.	9 Yr. and over
Iron and steel	11%	56%	11%	22%
Nonferrous metals	29	71	0	0
Machinery	12	56	12	20
Electrical machinery	29	57	7	7
Autos, trucks and parts	40	60	0	0
Transportation equipment (aircraft, ships, railroads)	7	53	20	20
Other metalworking	38	33	10	19
Chemicals	10	53	21	16
Paper and pulp	22	22	22	34
Rubber	33	33	34	0
Stone, clay and glass	0	57	36	7
Petroleum refining	16	50	17	17
Food and beverages	16	44	12	28
Textiles	37	47	5	11
Misc. manufacturing	9	52	13	26
All manufacturing*	18	50	14	18

*Answers to a similar question, in a 1955 McGraw-Hill survey, were as follows: 1-2 yr., 17%; 3-5 yr., 64%; 6-8 yr., 11%; 9 yr. or more, 8%.

gressive in designing and demonstrating new models.

The biggest obstacle—and one that presents a persistent problem—is the shortage of funds in many companies that need and want to modernize. For all corporations, the cash flow from retained earnings and depreciation has increased by more than $5 billion from 1953 to 1958. But a number of key industries have failed to keep pace with the general trend. These include some of the areas where the need for modernization is most urgent: the railroads, large sections of the textile industry, some mining industries and many small to medium-size companies in manufacturing generally. The problem of these industries and companies has grown more acute in 1958—since their profits have declined much more than the average for all business.

Any plan to step up the pace of modernization generally must deal with the special situation in these problem areas. Depressed industries and companies need outside help, if they are to modernize. Such help would include a stronger flow of technical information and advice (and occasionally, venture capital) from the more prosperous, inventive industries—as well as advice from equipment suppliers and distributors, industrial publishers and consultants. There is also a public responsibility to help in the problem areas—not with handouts of government money, but with technical assistance and help in finding private capital (like the efforts now being pursued by the Small Business Administration).

Certainly we should lose no time in reforming those provisions of the federal tax laws that now impede investment in modern equipment by hard-pressed firms—especially the outmoded and unfair restrictions on rates of depreciation for tax purposes. At present, the tax regulations require that depreciation be computed over relatively long periods of "useful life" for most types of equipment. And this is a primary reason for the lag in modernization. Machinery generally becomes obsolete long before the expiration of its "useful life" as specified in tax regulations. But it is difficult for companies—especially small companies—to set aside cash for rapid replacement, unless the full amount to be set aside is exempt from income tax. Canada and most European nations allow more rapid depreciation for tax purposes than does the United States.

A combination of self-help with technical help, and a fair break from the tax laws, would do much to reverse the spreading tide of obsolescence in depressed industries, and in many small companies.

PLAN '59

It is this combination that McGraw-Hill advocates as "PLAN '59" to help business modernize now for growth and profits. This is what it will take to make a start in 1959 on the $95 billion job of modernization, disclosed by the study we have just completed:

1. A better flow of technical information on where and how to modernize business plants and equipment.

2. Careful review by the individual company of its own opportunities to modernize at a profit—then action to replace obsolete facilities.

3. Reform of the tax laws, to allow more realistic deductions for depreciation, and permit more companies to finance adequate modernization programs from this source of funds.

Much of this program is already underway. The 34 McGraw-Hill Publications, and many suppliers and distributors of industrial equipment, have stepped up their information programs to start the modernization drive. Preliminary plans of manufacturing companies show a strong emphasis on capital spending for this purpose. In August, Congress passed a bill providing limited tax relief for small business.

But the real task of modernization still lies ahead. It is the greatest challenge, and the greatest opportunity, confronting American business as we move forward into 1959.

Industry Experts Answer the Question:

Modernization, Why and When?

Here you can "listen in "on the gist of an all-day panel* meeting at which modernization why's and wherefore's were explored in depth.

DO CHEMICAL process industries need modernization to meet the demands of the resurgent up-swing in business which economists believe is ahead for 1959? And, if so, should they get at it as quickly as possible—or wait until the upswing is more clearly marked than it is today?

These were questions that the editors of *Chemical Engineering* asked themselves as they plotted out this magazine's part in the "PLAN '59" campaign now being conducted by all 34 McGraw-Hill magazines to aid in speeding recovery of U. S. business from the 1958 recession.

Who should better know the answers to these important questions, we reasoned, than a properly selected group from the industry. We invited such a group to meet with us and tape-recorded the all-day session which resulted. The 114-page transcript was then condensed to its most significant points, as appears on the following ten pages.

Hosts at our panel meeting were S. D. Kirkpatrick, Editorial Director, and W. F. Traendly, Publisher. J. R. Callaham, Chief Editor, assisted by four senior editors, moderated the meeting.

The Panel consisted of three groups: one from the chemical process industries; one from the engineering and construction firms and consultants; and one from the equipment manufacturers. First of these, the CPI group, included Trumbull Blake, Robert J. DeLargey, Louis R. Goldsmith and Stuart R. Knapp. The construction-consultant group included Chester L. Knowles, Eugene R. Smoley, Samuel Strelzoff and E. Roy Sweet. In the equipment group were Walter E. Gutzwiller, William D. Kohlins, Emerson J. Lyons, George M. Muschamp and Elbert A. Sanford.

Procedure was to discuss a lengthy list of questions, bearing on the two main points under consideration, which had been given to Panel members in advance. In our condensation these have been rephrased as the ten questions appearing in bold-face type throughout the Panel-in-Print.

It developed that there are many facets to modernization. In some branches of the process industries it tends to be a continuous proposition with improvements introduced as fast as they become available. In others, especially some of the older industries, modernization is occasional rather than continuous. The Panel concluded that

* Who's who on the Panel, page 120.

somewhere between 15 and 25% of all process plants are in serious need of modernization, although this need tends to be a relative matter, determined largely by competitive factors in the particular industry.

To start off, let's first define what we mean by modernization.

Moderator—There are various viewpoints possible on the meaning of modernization and we discussed it among ourselves at considerable length, finally writing down the result. Here it is: "By modernization we mean changes to an *existing* plant made primarily, not to add to the capacity, but to bring the plant more nearly into line with best current practice."

Smoley—It should include removing bottlenecks in the existing plant.

Strelzoff—Changing the process to accept a more favorable raw material is included.

Lyons—We can't rule out capacity increase entirely since very often modernization has the definite aim of adding capacity by improving production efficiency.

Sweet—To amplify the definition a little, improvement according to the best of current practice includes also improving the over-all plant economy to reduce operating costs; meeting the latest end-product specifications; complying with new legal requirements on aerial and stream pollution, which might otherwise put you out of business; and upgrading raw materials which may no longer fit into your process scheme because of lower raw material quality due to depletion or changes in your source of supply.

Strelzoff—Modernization can include the use of better construction materials, too.

Knapp—We can sum this up by saying "Anything that improves the plant's competitive position."

What are the yardsticks, economic and otherwise, by which we can measure obsolescence and the need for modernization?

Goldsmith—In determining the need for modernization there's no substitute for an economic study in comparison with competitive producers. Of course, such a study is influenced by the kind of business you are in, the kind of competition you have, and the improvements in technology that are available.

DeLargey—There are often indirect benefits of modernization which can't be classed strictly as economic. I'm thinking of the improvement in employee and community relations that comes from a new and ship-shape plant. And better employee relations is often the key to economies in manpower utilization that you can't achieve in a sloppy or dangerous plant. Often a company's effort toward plant improvement will allow it to improve working practices which the labor relations situation otherwise would not permit. Thus, even these indirect benefits have economic implications.

Knowles—Aside from that, happier workers and operators do make for higher yields, better products and increased profits.

Smoley—The problem of labor availability comes into this. Processes requiring heavy labor may not be able to get workers at all—for example, the old zinc smelting retort furnaces which are now obsolete but once were operated by first-generation immigrants.

Knapp—Modernization is certainly tied to our competitive situation but I believe it must be a continuous proposition. If one plant fails to keep modern, at least one of its competitors will do so. A continuous study of modernization will prevent the position where management may suddenly find its plant no longer justifying continued operation.

DeLargey—It's dangerous to generalize about when to modernize—but there is a rough rule of thumb for management: after 15 years it's time for a good, hard look. This applies to heavy chemical plants, not to fast-moving industries such as drugs, for example. There are three reasons for this 15-year red flag: Technology and construction materials generally progress considerably in this interval; your plant is usually almost completely depreciated; and your umbrella of patents may be about to spring a big leak. On top of this your operating and maintenance labor costs have probably jumped ahead by 50-80% from your starting point.

Lyons—Product changes are responsible for a lot of modernization in the pharmaceutical industry, particularly in antibiotics. Most companies have been vigorously pursuing new ones of wider spectrum. One company, however, decided to stick to penicillin with the result that larger batches and newer methods enable them to make this material at a profit and at very low cost. So, while you can buy penicillin from many sources, most drug companies obtain it from this one supplier.

Strelzoff—One criterion we haven't mentioned is return on investment. So far as we know each chemical company has its own criteria for economic evaluation. One of the big concerns is rumored to consider nothing of interest unless it will bring a 25% return on the investment after taxes.

Knapp—That's a very attractive figure. Although there are certain rules regarding the general approach to return on investment, each project should be considered in its own right. Improvement of earning power of existing processes, promising new products, and projects necessary for safety improvements, are typical of items meriting special attention.

Question—Is it reasonable that a chemical concern should accept a labor-saving project, even if its return will be considerably less than that for a normal commercial project?

Blake—It's true that a labor-saving project should require less return. This is mainly because a payroll is a pretty substantial non-depreciable obligation. You can minimize it if you can reduce it by increased productivity. A payroll isn't like equipment which you can tear down and throw away when it wears out.

DeLargey—I think you can generally justify a modernization on a somewhat longer payout than a new venture. This is true, first, because you're already in the field, with an investment and an organization, and can't afford to let go. Secondly, you can generally get increased capacity through modernization more cheaply than by putting equal new investment into a new product. Lastly, your experience prior to the modernization reduces the risk factor as

compared with a new product, where you're plunging into the unknown.

Sweet—One very pressing criterion for modernization is the need to stay in business, or in a particular product, in the face of some external situation. For example, one of the companies in the nickel business found its percentage of the market was decreasing. It was forced to find new ore properties and develop a new process which was less economical than some of the other processes used—but it had to do this to remain in the nickel business.

Then there's another aspect of pollution control which I failed to mention before—the development of a byproduct business from the recovered material. A byproduct can even become more important than the main product in a pollution-control situation.

Lyons—There is one kind of modernization we haven't mentioned—pre-planned modernization for expansion. A typical case is that of a large new refinery which was thoroughly instrumented and wired back to a data-processing unit at the central control panel. They expect that eventually it will be necessary to automate the plant fully. When they do, the first steps will already have been taken.

Another example is that of a large ethylene plant designed to be built in three steps. Steps 1 and 2, now under construction, will make impure ethylene feed and purified product, respectively. In the planned future modernization, Step 3 will crack the ethane byproduct from Step 1 to ethylene feed for Step 2, where excess capacity is now being included.

Blake—We've been talking about modernization, with what seems to be the implication that a chemical company is likely to let things slide until it finds itself in trouble. I wouldn't want to be a party to that kind of program. With us, modernization is a living day-to-day thing. Very seldom do matters get to the point where we must rip things out and start over again. Our entire engineering department operates on a formal cost reduction program, right down to the individual engineer.

Goldsmith—I agree largely with Mr. Blake's stand. Modernization isn't the result of someone pushing a button and saying: "Now, let's modernize." The many live-wire engineers in most companies are always looking for better ways to do things, call this modernization, or cost reduction, or what you will. If you have a progressive management, then its philosophy is: "Let's be better than we are."

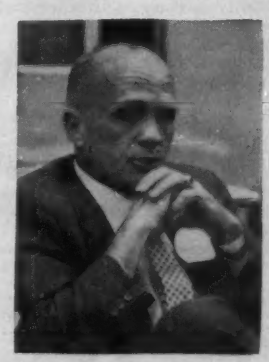
Sweet—As Mr. Blake points out, it's the engineer's normal day-to-day function to find better and less expensive ways of conducting a given operation. But, let's not lose sight of the fact that there are differences in degree and what we're largely concerned with here is the more formalized study of major modernization programs.

What percentage of chemical process plants seriously need modernization? Do certain types tend to become obsolete more rapidly than others?

Strelzoff—I don't think you can specify a definite percentage. Each section of the industry has to be studied individually. But there is one point I'd like to make—that chemical industries in general are striving for greater economy through bigger units.

Knapp—We can sum up our definition of modernization by saying "Anything that improves the plant's competitive position."

DeLargey—After 15 years . . . your umbrella of patents may be about to spring a big leak.



Blake—With us, modernization is a living day-to-day thing.

Smoley—My guess is that 25 to 50% of the chemical process plants need modernization now.

Muschamp Blake Sanford DeLargey Knowles Gutzwiller
Kohlins Goldsmith Lyons Strelzoff Smoley Knapp Sweet

Members of the Panel

Trumbull Blake—Special assistant to management of Engineering Service Division of DuPont's Engineering Dept., Wilmington, Blake's more than 20 years in engineering has been mainly in construction for DuPont and for DuPont-operated AEC projects such as Savannah River. He attended Harvard, has engineering degree from Tennessee Poly.

Robert J. DeLargey — Manager of Westvaco Chlor-Alkali Div., Food Machinery & Chemical Corp., New York, DeLargey holds a 1935 BS in ChE from Case. Before he joined FMC in 1951 he was in technological and management work with Shell Chemical. He reached his present position via engineering, management and production posts.

Louis R. Goldsmith—General Manager of Shell Oil Co.'s Manufacturing Technical Depts., New York, Goldsmith is in charge of research, technological, engineering and product application functions. He graduated in petroleum engineering in 1932 from University of California at Berkeley and has since been with Shell in various capacities.

Walter E. Gutzwiller—1921 EE graduate of the Technical Institute, Zurich, Switzerland, Gutzwiller came to the US in 1925 with American Brown-Boveri. For the past 27 years he has been with Allis-Chalmers, Milwaukee, in sales and application work for the electrochemical industry. He is now assistant to Manager of Electrical Application.

Stuart R. Knapp—Manager of DuPont's Engineering Service Div., Engineering Dept., Wilmington, Knapp is a 1931 ChE graduate of MIT (MS '32). In 1933 he joined DuPont, working in engineering capacities at various locations until 1943 when he returned to Wilmington. He has held his present post of ESD manager for the past six years.

Chester L. Knowles — Partner of Knowles Associates, New York, consulting engineers specializing on chemical, metallurgical and mechanical problems, Dr. Knowles received his degrees from University of Rhode Island and Brown. He gained his industrial experience with DuPont, The Dorr Co., and General American Transportation Corp.

William D. Kohlins—General Manager of Blaw-Knox Co.'s Buflovak Equipment Div., at Buffalo, Kohlins attended Princeton and CCNY and has a 1934 BS,ChE. Before entering the equipment field in 1940 he was with U. S. Gypsum and Mathieson. After six years with Swenson Evaporator he joined Buflovak in 1946 in sales, engineering and now management.

Emerson J. Lyons—As General Manager of General American's Turbo-Mixer Div., New York, Lyons is a career man in the mixing field. Receiving his BS,ChE in 1932 at University of Michigan he joined Skenandoa Rayon, becoming chief chemical engineer. His Turbo-Mixer connection dates from 1936, first in sales, now as Division manager.

George M. Muschamp — Engineering Vice-President of Minneapolis-Honeywell's Industrial Products Group, Philadelphia, Muschamp heads engineering for Brown Instrument and five other divisions. He is an ME graduate of Drexel Institute and since 1930 has been with Brown Instrument and M-H in patent work, engineering and engineering management.

Elbert A. Sanford—As Vice-President and Director of Research of The Pfaudler Co. division of Pfaudler-Permutit, Inc., Rochester, Sanford keeps in close touch with Pfaudler scholarships, fellowships and research projects at universities and research institutions, and with the company's plants abroad. He is a 1926 chemistry graduate from Harvard.

Eugene R. Smoley—Vice-President of the Lummus Co., New York, Smoley won BS, MS and PhD degrees in ChE from MIT. He worked in zinc, aluminum and oil industries before joining Lummus in 1934. With Lummus he progressed from process design, operation and sales engineering to his present position. Active in AIChE and other professional societies.

Samuel Strelzoff — Assistant to the President of Chemical Construction Corp., New York, Strelzoff earned his ChE degree at Liege, Belgium. Initially in the nitrogen industry in Belgium, he became TNT superintendent for the Canadian government, later joining American Cyanamid, then Chemico, in 1941. Until recently he headed sales.

E. Roy Sweet—As manager of chemical engineering for Singmaster & Breyer, New York, Sweet manages numerous types of project and consults on a variety of technical CPI topics. Following his 1943 BS in ChE from University of Rochester he worked for DuPont and Eastman Kodak, then went into consulting engineering, finally joining S & B in 1950.

Smoley—Most modern manufacturing industries tend to modernize as they go along and up-to-date companies are spending 5 to 10% of their initial investment per year in expansion and modernization. Of course, they may cut back in times such as these, but they'll go ahead on a project that can show a payout of less than two years. The heavy chemical industries and old-line industries like pulp and paper and the metals require less modernization, but still do a certain amount. My guess is that 25 to 50% of chemical process industries need modernization now.

DeLargey—In the past 20 years, when money has been readily available to the chemical industry, billions have been spent in modernizing and my guess as to the beat-up old plants now standing would be a lot less than 25%—perhaps 15% of the plants are economically on their last legs. Not only has there been a lot of money available through profits and investors' monies, but there has also been the powerful incentive of a constant rise in costs.

Goldsmith—I agree that you have to consider the various segments of the chemical process industries individually in judging the need for modernization. What would be a serious need in one industry might be a tolerable practice in another since this is primarily a competitive question—how bad off you are in comparison with your neighbors in the industry. Except, of course, I imagine any industry would jump at the chance for a payout of two years such as Mr. Smoley mentioned. This is something like a 20-25% return after taxes, and a very fine investment.

Sweet—The idea that older industries are less inclined to modernize is borne out by soda ash which is a mature, well-engineered industry. Profit margins are small and modernization at a minimum. I don't believe a completely new Solvay process soda plant has been built since 1935. However, the chlorine-caustic industry has been making a substantial encroachment on part of the soda industry's area, so it's evident that you can't isolate a given segment of the process industries without looking at encroaching areas of activity.

Knowles—My guess would be 15-20% of the CPI plants are in need of modernization. Like Mr. Sweet, I believe that the industries with the biggest tonnages and the lowest prices are least inclined to modernize. My candidates for the greatest modernization need would be cement, lime and ordinary superphosphate.

Goldsmith—It seems to me that the rate of obsolescence in process industries is pretty well tied to the amount of research effort going on in the various segments. Research is always looking for ways of making operations obsolete, while methods studies and operations research are finding ways to make your whole complex come out more favorably from an economic point of view.

Strelzoff—I'd say that, in general, heavy chemical industries obsolesce less rapidly than fine chemicals and pharmaceuticals, where research is bringing about product obsolescence every day. That doesn't happen at all in the heavy chemicals. The sulfuric acid process, for instance, is still where it was 25-30 years ago except for improvement in mechanical equipment. But only a study of each industry will tell you how badly they need modernization.

Sweet—Well, there have been some major revolutions in the ammonia industry since 1945, particularly with respect to the generation and purification of the synthesis gas. Shell's California plant was the first to use natural gas to make synthesis gas by steam-methane reforming at atmospheric pressure. Today you have a choice of the steam-methane process up to 125-150 psi., or the Texaco partial oxidation process.

Now, I think everyone agrees that these new processes are a substantial improvement, all other factors being equal. But all other factors *aren't* equal. A 1930 plant had a capital cost of 1/5 to 1/6 of an equal-capacity plant today. Weighing these low capital charges against the better operating characteristics of the new processes, we've found that you can't afford to replace the old "front end." Then, again, if you have your own natural gas supply and can charge it in at 5 or 10% of what your competition must pay—well, your old plant will be a very low-cost producer.

Kohlins—We keep coming back to the same thing, that while probably every plant in the world needs modernization, still, what is economic for one may be quite uneconomic for another. For example, most rayon plants convert glaubers salt from the spin bath into anhydrous sodium sulfate. And yet, one of the largest has studied this matter many times and can't justify it—perhaps because it can find other more profitable uses for its dollars.

Sanford—In the past we have seen some bad examples of obsolescence abroad. At present, however, we find people abroad are trying their best not only to do things as well as we do but to do them even better. This is especially true in Germany and Japan. We must keep our own plants up to date if we are to meet competition from abroad.

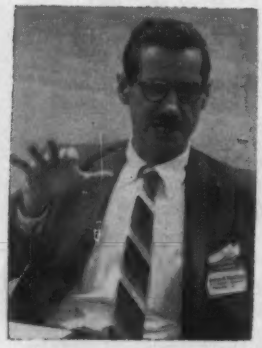
Even in our old, established industries there is always room for improvement. In evaporating sulfuric acid, for example, we have recently seen lead replaced to a considerable degree by tantalum for heating. And the pulp and paper industry is now making extensive use of chlorine dioxide for pulp bleaching.

Do chemical process plants tend to become obsolete in toto or in part?

Sweet—It seems to me that with the possible exception of cases where a product becomes obsolete, process plants rarely if ever become obsolete in their entirety at one time. Take the phenol business, for example. There are four basic processes available today. For one special situation, or another, any of the four may be the proper choice. On the other hand, in industries where the product becomes obsolete—the drug and pharmaceutical or dye industries, for instance—there is a peculiar situation with respect to most of the equipment which prevents such obsolescence from becoming disastrous. Except for certain specialized types of equipment, most of the equipment used in the pharmaceutical and dye industries is common to a variety of products. A glass-lined kettle used for making Product A can also be used to make Product B. Also, these industries have a very high rate of payout during the initial period

Knowles—Industries with the biggest tonnages and the lowest prices are least inclined to modernize.

Goldsmith — The rate of obsolescence in process industries is pretty well tied to the amount of research effort . . . Research is always looking for ways of making operations obsolete.



Muschamp — When you're investing in a plant or process . . . you tend to reach an asymptote where additional dollars account for less and less improvement.

of appearance of ethical products, so that they can afford to switch to new products.

Smoley—Parts of the over-all process can become obsolete very quickly. In the petroleum refining industry the wax pressing process became completely obsolete when the solvent dewaxing and refining process came in. Unlike the case of pharmaceuticals, this equipment was scrapped completely. There was a similar situation when catalytic cracking displaced thermal cracking. The refineries couldn't afford not to go to catalytic cracking if they wanted to stay competitive in gasoline.

All sorts of technological developments are taking place constantly—in industry, in government, in the schools and research institutes—so that any process concern can easily find places where it can modernize immediately. The refineries are always considering a whole array of possible projects for modernization—making perhaps as many as 200 or 300 studies —with managements weighing one improvement against another and trying to decide how to spend their money most effectively.

Knowles—I think many big tonnage operations can save money most quickly and most economically by improving their materials handling, packaging, warehousing and storage. We have learned a lot about lift trucks and pallets in the last 20 years. Sometimes these relatively simple non-process improvements can be rather spectacular. Although this may not be chemical engineering, we chemical engineering consultants do quite a lot of it—even to designing better office buildings and change houses. We don't necessarily stick to our chemical engineering.

Gutzwiller—To supplement Mr. Knowles' comments on material handling, packaging and storage, there are ample opportunities in these areas for cost reduction, especially where heavy tonnages are involved. Equipment such as fork-lift trucks, pallets, front-end loaders, towing tractors, and bulldozers can help materially to cut handling costs. The use of compacting machinery has also proven highly successful in forming easily handled granular products from fines and has materially reduced dust losses.

Also, I'd like to comment on the electrochemical industries. After World War II a large amount of surplus ac.-to-dc. mercury-arc-type power conversion equipment was thrown on the secondhand equipment market. Most of this equipment, much in new or good condition, was purchased by the chlor-alkali industry at a low price. Some of this equipment has become obsolete as far as conversion efficiency and maintenance cost are concerned. However, its replacement by more modern mercury-arc types has been difficult to justify because of the low initial cost of this secondhand equipment.

However, with the development of the semi-conductor (silicon) rectifier, which has a 4-5% higher conversion efficiency than the mercury-arc rectifier at medium dc. voltages, replacement of the older types of conversion equipment may now be justified economically. Such replacements should be considered where the cost of electric power is high and where power cost represents a sizable portion of the cost of an electrolytic product.

Muschamp—When you're investing in a plant or process the degree of improvement vs. the money invested is like everything else in nature—you tend to reach an asymptote where additional dollars account for less and less improvement. Instrumentation can make a dramatic contribution in many cases where this area of diminishing returns on process equipment investment has been reached. Perhaps the contribution will be more dramatic where you're dealing with a whole-cloth new process and you can design the instrumentation from scratch, but a comparatively small instrument investment can have important consequences compared with other kinds of equipment investment in cases of partial modernization. We've seen this take place in plants where there was insufficient incentive from competition to justify major expenditures in basic equipment.

What are the best methods for determining what needs to be modernized, and how to do it?

DeLargey—The conventional staff function that has modernization as its responsibility is usually concerned with *process*—for example, the plant process department. However, the chemical industry and chemical engineers seem to have a blind spot so far as manpower costs are concerned. A well instrumented plant may have a payroll cost under 10% of the sales dollars, but manpower costs run 20 to 30% in a good many plants. Chemical plant managements are generally trained in process thinking and don't naturally think in terms of manpower costs.

In fact, in the average chemical operation one gets used to seeing people "standing by." You'll often find people being utilized only 35% of their time. But, compare this with a good mechanical industries operation where manpower is utilized close to 80% of the time. This suggests to me that, in looking for modernization opportunities, we could all do well to think about what we might call the *industrial* engineering aspects of the process.

Comment—Yes, but—you can't cut a man in half, and often in dangerous or critical operations we have to supply two men where one would do, simply because we must provide for his sudden illness or incapacitation.

DeLargey—I'll agree with you—if your payroll is no more than 5 to 10% of your sales dollar. If it's 20% or higher, then you'd better explore seriously whether your process engineers do have a blind spot.

Knapp—We have an approach to this modernization survey problem which should avoid the blind spot. We use the task force type of approach, including people from the line organization—the industrial departments that make the products—with somebody from research, usually someone from sales. The engineering department contributes staff assistance, utilizing people from engineering research, various consulting specialties, estimation and design. Many times such a team has brought about results that would have been impossible individually. One of the big advantages of this approach is that it brings in the viewpoint of the line organization so that the survey's results won't be taken as a criticism of the line departments. And the task force brings in experts not only on process, equipment and services, but also on the manpower and sales problems as well.

Sweet—The task force approach is fine for a big and broadly experienced concern. Where a company hasn't such facilities we, as an engineering firm, often get involved in a situation which is very difficult for us—and not the best for the project. We'll be pushed for time—usually with penalties in the contract—to the extent that we must concentrate on building the plant, without any opportuniy to consider refinements. A modernization project is likely to be even worse than a new plant project since you have to interrupt an existing operation to switch a new step into the line.

Goldsmith—I agree that the task force idea is a fine method if the problem is of this magnitude—and the people are available. Sometimes we use a different approach—a one-man task force who has several kinds of necessary experience and background. He'll head the whole project, but will make sure that he brings in all the various elements in the company who must be considered—people in operation, process and mechanical design, research, marketing, and so on. The result is similar to that of the task force, but not so formalized.

Question—What kind of man would you select for this job?

Goldsmith—He'll usually be a chemical engineer, as high up the line as possible, providing he embodies the needed characteristics. An assistant department manager from the head office, or possibly an equivalent refinery man with at least 10 or 15 years experience and a wide background.

DeLargey—We've found that a very useful man for this task force approach is one with original technical training who has been exposed to a lot of financial and accounting work in his later experience. It takes a kind of wizard who knows plant operations thoroughly and yet appreciates the cost system to be able to dig out the true cost facts from the records and find which are truly amenable to improvement. Such a man, if he has an appreciation of the profit picture, and of the principles of investment under which the company operates, can save a lot of time in getting at the real meat of the matter.

Strelzoff—Without any intention of propagandizing, I'd like to put in a good word for the outside viewpoint in modernization studies. I've been on both sides of the picture so I believe I can see all sides to the question.

The task force idea is excellent because it gives the group a broad viewpoint, not unduly influenced by one division's thinking. But it's not always possible. I feel that the initiative for a modernization will usually come from the sales department. Once the decision has been made to do something about it the company can use the task force or individual approach—but it might be better off to take the problem to an outside organization. The outside group can supply necessary skills and take a suitably detached viewpoint independent of sometimes conflicting interests within the company.

Lyons—Let's not overlook the equipment manufacturer as a source of help in modernization surveys. The small company that hasn't the facilities for a task force, and possibly can't afford a purchased outside review, can find a lot of specialized knowledge and experience among the equipment makers' engineers. The equipment company ordinarily has laboratory facilities and can usually offer improvement and modernization ideas without extended research.

Sweet—I think we're all talking about the same thing. The job in hand calls for a present-day Leonardo daVinci. If we can't find him in one man we have to put together a composite man in the form of a task force or something similar. There are two ways to do this: a subjective method using an internal task force; and an objective method, using an outside organization. The outside group can maintain an objective attitude sometimes not possible within the chemical concern. But the internal task force certainly has a thorough knowledge of the company's operations which the outside group would have to acquire the hard way.

Goldsmith—I want to emphasize still another angle

Sweet — There are good economic reasons for modernizing now since substantial cost savings can be made.

Strelzoff—You can't stop obsolescence. You build a plant and it's at least partially obsolete almost before you can start it up.

Lyons — It seems to me that the venturesome company would take advantage of today's prices for modernization in expectation of selling in tomorrow's (further inflated) market.

to this problem. It's important that management, as far up the line as possible, be brought into the act early, and kept in it during the survey. Also other groups such as manufacturing, research, sales and transportation. This way you avoid the possibility of overlooking some management approach which could completely nullify your results. And, at the same time, you secure the cooperation of all elements of the company.

Muschamp—We've heard two approaches to this modernization problem: the *continuous* cost-reduction or modernization idea described by Messrs. Blake and Goldsmith; and the major-project idea, with its task force or outside assistance. I'd like to point out an advantage of the continuous cost-reduction idea, namely, that it can be made to pervade the whole organization. Thus, it's not limited to the relatively few levels usually involved in "one-shot" attempts at modernization. Some of the things you're concerned with will turn on details that go pretty far down the organization—where outside consultation would be clearly prohibitive. So, we should have a flexible approach to these things which doesn't limit us to one method of getting at our answers.

Can we predict the results of a modernization program; how well will predictions compare with actual results?

DeLargey—I mentioned before that a technical man with financial training is a very handy adjunct to a modernization survey. He is also the man best able to predict what results you'll achieve—what will happen to your balance sheet.

Sweet—It seems to me there are two opposing viewpoints on this question. Looked at from the operating company's standpoint, you already have some experience in the process and it should be possible to predict the effect of the improvements on operating and manpower costs, reduction in power services and increase in yields, at least as accurately as you can make any estimate. However, from the viewpoint of the engineering and construction firm, a modernization program is one of the trickiest to predetermine. This is because the construction phases are tied in with an existing operation. You never know when the plant manager will decree that you must keep your men out of the area for X hours because they'll be exhausting hydrogen—or when that railroad spur will be tied up so you can't bring equipment in.

In fact, pre-modernization capital cost estimates are probably the least accurate you can prepare, for which reason engineering firms are extremely reluctant—or completely unwilling—to give lump-sum or maximum-guarantee bids on such work.

Kohlins—Obviously, the more different kinds of talent you can bring to bear on a modernization project, the better your predictions will be. Even with DuPont's vast range of talents, I'm sure they call on outside construction assistance and on the equipment manufacturers when they come into an area where they haven't had particular experience.

When should a plant carry out needed modernization—now, or wait for better business?

Sweet—Sometimes you can't wait if you want to stay in business. I've already mentioned the possibility of your being shut down on account of new pollution legislation. Or your previous raw material may become unavailable. Without such a threat, there are still good economic reasons for modernizing now since substantial cost savings can be made.

Strelzoff—There's another kind of threat which seems to me to bring some urgency into the modernization picture. It impressed me when I attended the German ACHEMA in June. Everybody was amazed at the high quality of the European equipment shown. Neither the equipment manufacturer nor the process concern here in the United States can afford to sleep in the face of the resurgence of German equipment and process industry products.

DeLargey—Right now the equipment and construction firms aren't too busy. I'd like to throw in a comment on the reverse side of the picture. Part of our own modernization construction was carried out at a time of intense construction activity in that area. Some of the needed crafts had to be drawn in from many surrounding states and were in such short supply that the contractors couldn't exert much control over either the productivity or the work quality of those crafts. This resulted in a 10% over-run on construction costs—in fact, even higher in some cases I know of.

However, even though this is the time to get bargains in construction costs, I'd like to emphasize one point. Often a major incentive to modernize is the extra capacity you can add cheaply. It's a sad and unprofitable thing to add capacity when over-capacity already exists. The magic time to put a modernization-expansion program is just before you need the extra capacity—and it's one of the highest skills of management to be able to determine that.

Sweet—Well, here's something to think about—the inflationary trend. As a specific example of what has been happening, consider a long-time client of ours who is in the non-ferrous metal business. Over the period from 1945 to 1953 we made a series of estimates on a new electrolytic plant to be built for this client for the same capacity and at the same site. With each estimate it turned out that the return on the investment would not be justified. But, and here's the interesting thing, in each case the investment would have been justified if we could couple that particular investment with the income picture at the time of the next estimate, a year and a half later. Inflation being what it is, I believe this same situation holds true for the chemical industry in general. And it seems likely we'll soon iron out the over-capacity even in such over-built industries as nitrogen and chlor-alkali.

To support this position, look at the way one specific class of equipment has increased in cost. In the course of an appraisal job at the Morgantown Ordnance Works ammonia plant we found that coke oven costs have varied as follows: $40,000 in 1930; $100,000 in 1943; and $240,000 (a firm quotation) in 1958, all per daily ton capacity.

(This proposition developed considerable discussion, without a final conclusion, Mr. DeLargey supporting the contention that the time to build is just before you need the capacity, Mr. Sweet maintaining that the time to build is as far back as you can support the fixed charges on idle equipment until demand catches up. That brought up the question: How far back can you build and still be modern?—Ed.)

Strelzoff—I think we can go back to some of our earlier discussion to show why we should modernize now. You can't stop obsolescence. You build a plant and it's at least partially obsolete almost before you can start it up. That's why, as Mr. Blake said, modernization is a living day-to-day thing in a free-enterprise situation such as ours. The pre-war European nitrogen cartel was able to stop progress in Europe's nitrogen industry, but you can't do it here.

Comment—Suppose technology hasn't yet caught up; is that a reason for waiting to modernize? As an example, you may feel that semi-conductor rectifiers are the coming thing, but you fear they're not sufficiently developed. Should you postpone modernizing—or else develop your own technology?

Kohlins—If I understand the comment it means you'd better not do anything today since tomorrow will have something better to offer. With this philosophy nothing would ever be done. The criterion is that changes should be made as soon as they can economically be justified.

Comment—There's one good example of where you'll have to wait—full automation through computer control.

Muschamp—The objective of modernization is to save a dollar now. But it's likely to be some time before computer control becomes generally applicable. There are, of course, a lot of experiments going on which are seeking an automatic way of correlating our environmental automatic controls—the job the operator now does manually. Our company makes a $200 machine—a computer if you will—to linearize flow readings. It also makes a $2,000,000 machine to handle data processing. In the development of computer control we're now at about the $100,000 level, or will be in six months or a year, so you might say we're now removed by a factor of 20 to 1 from the $2,000,000 machine that may be able to relate all the process and management variables we're talking about.

Goldsmith—These comments are another way of saying again that by definition a process isn't obsolete until there is a better way of doing it.

What are the advantages—or disadvantages—of modernizing now?

Sweet—Today's building costs are a very real advantage. Somewhat over a year ago we entered into a maximum-guarantee contract with a major chemical company for the engineering and construction of a facility in the $10,000,000 range. We find today that we can buy both equipment and subcontract work at substantial reductions—steelwork fabricated and erected substantially under the estimate, for example, and we should have been able to estimate that right on the nose.

Strelzoff—There are a lot of favorable factors today—improved engineer efficiency and worker productivity, availability of both engineers and construction workers, good deliveries and favorable terms on equipment. Engineering forces have been stabilized and the job-jumpers and deadwood eliminated. I'd say it's the best time in the last five years for a new project, and probably the best in the next five since we're bound to continue with inflation. Nobody's stopped inflation in the last 2,000 years, barring the dips due to depressions.

Goldsmith—I don't believe inflation as such makes too much difference in whether we build now or later since at any given time there's a more or less fixed relation between the value of the dollars you'll pay out for plant, and the dollars that will come back for your product. Of course, your accumulated depreciation reserves become less valuable as inflation proceeds, but the main point I want to make is to second Mr. Strelzoff. Compared to a time when everybody is trying to build, and the present, I'd say there might

Sanford—Equipment quality today is the best I've ever seen, while labor relations are excellent and labor productivity is high.

Gutzwiller—We don't expect the chemical industry will be able to buy heavy equipment any cheaper than it can today.

Kohlins — If (we have) over-capacity (in chemicals) . . . isn't that a very cogent reason for modernizing now (so plants) can operate profitably at less than peak capacity?

be as much as a 25% differential in favor of now.

Lyons—I wonder if we ought to accept Mr. Goldsmith's philosophy on the lack of effect of inflation? It seems to me that the venturesome company would take advantage of today's prices for modernization in expectation of selling in tomorrow's market.

DeLargey—We mustn't forget that each company's own financial situation has a bearing on its ability to plunge a lot of capital into modernization now. Earnings of heavy industry have been off substantially and so the trend is to seek external financing. For debt financing, interest rates are down considerably compared with a year or two ago, but the situation in equity financing is volatile and varies a great deal with the company's total financing picture.

Sanford—I'd like to comment that equipment quality today is the best I've ever seen, while labor relations are excellent and labor productivity is high.

Lyons—That's true, and deliveries are excellent, at a good price. Prices of equipment have risen about 20 to 25% in the last five years and I'd expect a straight-line increase of another 20 to 25% in the next five years.

How do you expect plant and equipment prices to move in the next few years? What economic trends do you anticipate?

Gutzwiller—At present there are no material, labor and facilities shortages in the heavy equipment industry. Shipments run from 6 months for light and medium equipment to 12 months for the heavier varieties.

We don't expect the chemical industry will be able to buy heavy equipment any cheaper than it can today. In the manufacture of heavy machinery, rising costs of material and labor can't be offset entirely by more efficient production and better tooling, because there is generally not enough repetitive manufacturing. Much of this equipment must be specially engineered and thus is more or less tailor-made.

The trend to higher prices will continue as long as labor and material costs continue to increase.

Kohlins—There is another angle to this. With increasing complexity of process industries, the proportion of equipment cost that comes from material has continued to increase. When we made most equipment from cast iron or carbon steel, then labor was a more important cost component. Now, with much equipment made of expensive metals or alloys, the equipment maker has less control over the cost of his product than formerly. Improving his own production efficiency won't have as much effect as you might expect, except insofar as better design and production efficiency can conserve materials.

Muschamp—There is another ingredient in the cost of equipment which we in the instrument field call systems engineering. Call it engineering help given to the user by the equipment maker, to aid him in making the best possible application of his equipment—or call it free consulting, if you will. It's becoming a terrifically important thing in modernization evaluations and designs, and it's gone about as far as it can go—and still be included in equipment prices. Some manufacturers are already pricing such service separately. The alternative seems to be for the user to provide more of his own systems engineering, or else to farm it out to contracting engineers.

Strelzoff—From the equipment cost trend of the last few years I'd expect about a 2 or 3% increase per year—perhaps 25% by 1965. Today's million dollar plant would cost $1,250,000 by 1965.

Knowles—I'm not an economist but I don't expect we'll drag bottom very long. I'll go along with Mr. Strelzoff on his 1965 figure, and interpolate $1,100,000 for 1960.

DeLargey—I'm not quite so optimistic on the rate of recovery from the 1958 recession. In most major chemical areas we have considerable surplus capacity due both to the intensive expansion of the last ten years, and to the dwindling of foreign markets with

the resurgence of chemical production in Germany, Europe in general, and Japan. I'm thinking in terms of two or three years before there will be a strong demand picture in many basic chemicals.

Kohlins—If Mr. DeLargey's comments about overcapacity are correct, and I don't doubt they are, isn't that a very cogent reason for modernization now? Operating at less than capacity, these plants will probably have high unit costs and therefore will need improvement now so that they can operate profitably at less than peak capacity.

Smoley—There are a lot of imponderables in the economic future, but some of the things that will have a major effect on how long we take to catch up with our capacity are our international relations—with possible government stockpiling—and what happens to the 1959 automobile. I'd check Mr. Knowles on the 1960 price rise and perhaps go to $1,300,000 for the 1965 figure. How fast we break through on some of the important technological developments could have a very important effect.

What are some good examples of recent modernizations trends?

Knapp—In one recent modernization I'm familiar with, only about 50% of the improvement came from process changes. The non-process aspects such as power facilities and materials handling turned out to be equally as important—a fact that management should have in mind.

Moderator—We've had some earlier comments along the same line. Any other examples, either process or non-process?

Smoley—This one might be considered half way between. In one recent case we substituted a turbine-driven centrifugal compressor for five reciprocating units. The investment was over half a million dollars but it paid off in less than a year in maintenance savings and other advantages. In a number of other instances we've modernized oil heaters in refineries by putting one of our new furnaces on skids, demolishing and removing the old heater and connecting up the new one with only about one-fourth the usual loss of time. The new furnaces pay out quickly in the fuel they save.

Strelzoff—A good many chemical industry improvements in recent years have been possible owing to the availability of tonnage oxygen at a considerably reduced price. About 65% of the increase in acetylene output in the last few years has come from natural gas through the use of new processes, primarily oxidation. This is a good example of where a major change in the cost of a raw material has had a great effect on the technology of a whole sector of the chemical industry.

Sanford—One of our most popular products is a conical vacuum dryer which is cutting drying time as much as 90%, compared to the older process, and labor costs as much as 50% per pound of product.

Lyons—There's a good example in the reaction-equipment field. In a synthetic urea plant installed a few years ago, the reaction equipment cost about $1,250,000. As a result of intensive mixer study this equipment is now being replaced with new equipment having about 50% more capacity—but at less than half the cost. Another example is the replacement of packed columns with improved extraction equipment. In several such cases we have been able to provide better recoveries with marked operating improvements.

DeLargey—At one of our plants our company is approaching the finish of a six-year modernization which amounts to a complete overhaul. (This is described in a separate article in this issue.—Ed.) The entire spirit and operating philosophy of the plant has been made over, from the janitor on up, and the program is having a major effect on community relations—all this quite apart from the improvements in plant economy.

Kohlins—I'd like to cite a couple of cases of product modernization, as distinguished from plant modernization. One product was a concentrated liquid which, it was said, could not be reduced to a solid. Now this has been done with consequent major savings in shipping, handling and storage. Another product formerly handled as a bulky solid is now being processed to small particles which are easier to handle. Making the product a little cheaper is fine, but a product modernization that yields savings for the user also improves the product's competitive position. This is an often-overlooked area.

Muschamp—There are many examples of savings that followed the use of new instruments. I'd like to mention a couple. At one extreme was a case where a refinery reduced its work force 75% while increasing its throughput. At the other was an installation of a $7,000 infrared analyzer which paid out in a couple of months.

Gutzwiller—Our company has modernized the ac.-to-dc. power conversion equipment in a number of chlorine plants by replacing multi-anode type rectifiers with the more efficient single-anode type, using existing transformer and switchgear equipment. Conversion efficiency gains were 2-3%. In some cases, the existing chlorine cells have been uprated 10-20% by adding more anodes to the cells and improving the terminal facilities and bus work of the cells. With the modernization of the conversion equipment, a modest increase in plant capacity was possible at a relatively low investment per ton of additional capacity.

More of this type of modernization can be expected in existing chlorine plants before many new plants will be built.

Sweet—Should we wind this up with a horrible example—where there was a failure to modernize? I'm referring to the ammonia plant at the Morgantown Ordnance Works. Since this government-owned plant was built in 1941, it has had three industry operators. The operators could maintain the plant in status quo condition but the process could not be altered. The plant is so obsolete today that the present operator, Olin-Mathieson, is giving up its lease and will vacate the plant on November 23. The local power company will lose its largest customer, the coal suppliers will lose a market for several hundred thousand tons a year, and the employment roll in the area will drop by 1,100—the total employment of the plant.

Moderator—Without modernization, it could happen to you!

PLAN '59

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INTERNAL task force—has thorough knowledge of company operations

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LESLIE A. McCLAINE and ELLIOT SCHRIER, Arthur D. Little, Inc., San Francisco, Calif.

GIVE an engineer an assignment to modernize his plant, and eight times out of eleven he'll think first of his auxiliary equipment—heat exchangers, columns, pumps, piping, etc. Give a management man an assignment to modernize his company's production operation, and seven times out of nine he'll think first of automation—data handling and storage systems, automatic logging devices, automatic pumps and valves, and the computer. (These results are from an informal survey conducted by one of the authors.)

All too often the process, which is the real justification for the plant, is left to age gracefully. But unlike paintings, processes are not enhanced by their settings; new heat exchangers, new pumps and brightly painted piping can do little to make an obsolescent process competitive. Indeed, such equipment can represent money down the drain unless accompanied by a process modernization. A periodic review by a team representing many skills and broad industrial experience is proposed as a beginning to a process modernization.

Process Obsolescence

Processes do not wear out in the same way as equipment does; process obsolescence is a relative aging phenomenon rather than a discrete occurrence. It's as dependent on what industry as a whole is doing as on the company's own research and development activities. Changes in process feed, materials of construction, product end-use patterns contribute to process obsolescence. Today there might be a development in distillation, tomorrow one in extraction, the day after one in reaction kinetics, and the day after that one in thermodynamics. No one development necessarily makes yesterday's process obsolete, but each contributes to obsolescence.

Industry, of course, is continually striving to counteract process obsolescence. Engineering management thus is continually faced with the task of deciding when to make which process changes. Obviously this decision-making activity calls for a thorough knowledge of technological developments since the process was placed on stream. Unfortunately, this knowledge is becoming more difficult to obtain as the rate of technological development accelerates. Yet this very acceleration makes it important to keep your process up-to-date.

Economic Reasons to Up-Date

As industry's technological base gets more and more complex and as processes become more sophisticated, it's increasingly difficult for plant managers—no matter how skilled, experienced or diligent—to overcome the handicap imposed by out-of-date applications of unit operations and processes. In spite of today's higher construction costs, a new plant is generally able to turn out lower cost products—not simply because it is new, but because it incorporates the latest chemical engineering developments.

We have all heard about the "profit squeeze." Labor costs, distribution costs, raw material costs and hidden costs (as for odor control and community relations) are taking greater portions of the sales dollar. And just about the only way to assure reasonable profits and still retain sufficient capital for further expansion is through more efficient operation of the process itself, producing lower processing costs.

Conceivably, just the improvements in distillation column design in the past decade could, if grafted onto a quarter century old plant, make the difference between a competitive and a non-competitive product. Maintenance simplification, through introduction of new equipment designs, new materials of construction and new materials handling systems, could cut unit costs through decreased down-time; and down-time is becoming increasingly important as the cost per ton of installed capacity continues to increase steadily.

Let's consider another aspect of the situation: increasing and conflicting demands for capital. Research and development expenditures are increasing yearly as companies prepare for the future. The pharmaceutical, petrochemical and other chemical process industries have become industries based on continuing research and development. Since research and development activities lead to new products or processes, ultimate implementation of the results of the research and development effort leads inevitably to capital outlay for new manufacturing facilities. Thus, a company with limited capital often has to make-do with existing

production facilities for existing products to obtain new production facilities for new products.

Finally, capital is often required to build new plants to service new markets or geographical areas that, because of increasing distribution costs, availability of raw material supplies or regional industrial growth such as in the South and Far West, can no longer be serviced out of existing plants in other parts of the country.

Process Survey is Team Affair

But there is more than one way to skin a cat. If we can't get capital for entirely new plants based on all-new processes, we can apply our technological skills to modernize existing plants and processes to incorporate up-to-date chemical engineering practice. Indeed, this might be the greater challenge to our skills. A check-up of the process is one way to meet that challenge.

The concept of a process review arose from the need to maintain process operations at peak efficiency by rapid assimilation of technical advances. It's really an attempt to speed up the transfer of technical knowledge to industrial practice.

The team required to make the process survey should include, as needed, chemical engineers, mechanical engineers, chemists, control engineers, mathematicians and technical economists. In addition to having a wide range of skills the team should also bring to bear experience from a wide range of industries where possible. Often standard practice in one industry might be just the solution to a knotty problem in another industry. If the company is diversified enough, the necessary skills should be within its own staff (e.g., a central engineering department). Sometimes though, even large chemical companies may find it cheaper and quicker to hire a contract research organization having a wide variety of background, disciplines, experience and objectivity.

No matter what its origin, however, the multi-skilled team would undertake a careful, considered, knowledgeable appraisal of the market situation and outlook; of the process as it operates (efficiencies, economics); of the various individual elements within the process (unit operations, unit processes); of alternate methods of accomplishing the same thing (raw materials, equipment); of contemporary chemical engineering practice within related industries and borrowable from essentially unrelated industries (literature, licensing); and of possible changes based on original findings (improvements, inventions).

Note that this approach is probably more applicable to effecting improvements in the performance of a successful-but-dated plant than of a basically unsuccessful plant. And it follows much the same thought patterns long involved in technical and economic evaluations of proposed projects, save that here we are dealing with an existing operation with a sizable investment that cannot be junked lightly.

Main Areas of Process Review

The process survey itself is at present more a concept than a proven technique. Few companies have conducted a truly complete survey in the detail discussed here. Yet each part of the check-up has been accomplished in a number of industries on proposed projects and existing plants by both internal staffs and outside consultants. Thus, the value of the individual components has been time tested. A complete review of all phases of a single operation could prove more valuable than the sum of the parts.

For purposes of discussion we may divide a process survey into four areas: chemical engineering, process chemistry, control procedure, and cost.

Chemical Engineering — The chemical engineering review would be concerned with the flow and transfer of mass and energy, and the modern techniques, materials and equipment necessary to get the job done. While most of the work may be carried out by chemical engineers, the other team members will also be vitally concerned with development of the information. The knowledge of process efficiency, as indicated by the energy and material balances, will interest all the team as an indication of areas warranting study and as a stimulus to the generation of ideas for process improvement. Likewise, the operation will be reviewed by all team members to promote the adoption of new operating techniques from their experience in other related or unrelated industries.

Process Chemistry—The process chemistry review would examine the process from the standpoint of the thermodynamics, kinetics, chemical mechanisms and surface chemistry involved. Plant operating experience will be probed to obtain clues to misapplication of any chemical reactions involved in the process. The primary variables that should be controlled and the areas of the operation subject to improvement will be pinpointed. This review will result in an outline of the theoretical optimum operating conditions based on thermochemical and kinetic considerations. If additional data are required to set such conditions, a laboratory or pilot-plant program to obtain them will be formulated. Again the information will be of interest to all members of the team as a means of spotlighting sources of recurrent operational problems and of providing a measure of the plant's current success in operating at the optimum.

Control Procedures—The process control review would survey present and potential control procedures with the object of recommending the optimum control methods, number of sampling points and sample scheduling. Development of this information will demand a team effort to determine the required control variables and the most practical control points. The reviewers must then work with analytical specialists, electronic specialists and others to determine the optimum control methods, and with statisticians to determine the optimum sample scheduling. All team members will want to examine and evaluate the review in the light of their own training and experience.

Costs—Process cost analyses will be an essential part of all phases of the process review. These analyses will provide a measure of performance of the existing process and will stimulate thought concerning needs and areas for process modifications. In addition, they will be required when the economic worth of various suggested process modifications, equipment changes and control systems are considered.

After all, the process survey is proposed as a means of increasing

profitability through increased technical efficiency. Effort expended in considering equipment modifications, raw material changes, increased process efficiency in utilizing materials and energy, methods of reducing operating maintenance and equipment costs, etc., must be directed on the basis of the potential returns in increased profitability. Only process modifications which will provide maximum increases in profitability of the overall operation as well as increased technical efficiency will be warranted. Cost analyses on proposed modifications can also provide management with the necessary information to incorporate them properly into plant practice.

While it's certainly essential that the team contain some members who are familiar with the details of the industry being reviewed, there may be added advantages if some members do not have previous wide and detailed experience with this particular industry. Lack of familiarity with current practice in an industry may inject a needed critical, objective viewpoint.

Here Are Typical Results

The review techniques are not new, and many examples of specific process modernizations achieved by proper combination of experience and training can be cited.

One startling development of a new technique based on presumably unrelated experience is the open-hearth jet tapper. The jet tapper is a shaped charge of high explosive which is placed at the tap hole and ignited from a safe distance. It replaces the hand operation of burning through the refractory plug with a short oxygen lance, which exposes the operator to injury when the plug is punctured and the melt spews out. The jet tapper resulted from an individual with experience in both the military use of shaped charges and the art of steel making, although he had not worked on a better tapping method before. Tapping open hearth furnaces had long been recognized as a hazardous operation, but until this individual considered the problems, no one had recognized the obvious application of shaped charges.

Another instance of process modernization is in the field of uranium metallurgy. This case demonstrates how a review of process chemistry outlined a research problem, whose solution materially improved the process economics. The cost of potassium permanganate required to oxidize uraninite and pitchblende minerals in the carbonate leaching of uranium ores is extremely high. In the course of a process review, thermodynamic calculations indicated that oxidation could be achieved by air under normal atmospheric pressure. However the rate of air oxidation is extremely slow unless several atmospheres of oxygen pressure are used. Thus the use or need for a catalyst was indicated to avoid expensive high-pressure leaching equipment.

The literature revealed that air oxidation of various materials was frequently achieved more rapidly by the use of homogeneous catalysts. As a result of this review, a research program was outlined which ultimately led to atmospheric air oxidation of uraninite, catalyzed by copper ions. The process is currently used in at least one mill on the Colorado Plateau. Copper in quantities of only 10 to 100 parts per million combined with adequate aeration of the pulp replaces the use of potassium permanganate in quantities on the order of a thousand parts per million, substantially lowering unit costs.

Modernization Pays Off

We've given examples of process improvement resulting from bringing new and/or varied training and experience to bear on specific process problems. In most instances these problems can be recognized from a review utilizing a performance yardstick such as a mass or energy balance, thermodynamic calculation and cost analysis.

The process survey utilizes proven review techniques. These reviews occur over the years in the evolution of any commercial process. But application of the survey on a periodic basis will permit continuing development of the process and a more rapid translation of new developments into process modifications which will improve the overall economic efficiency of the plant. It will eliminate the possibility of misguided in-plant process modification after the process has been installed—when all too often it becomes modified without adequate consideration of process chemistry.

In conclusion, we should point out that the process review as proposed herein is only one part of the overall approach to industrial modernization. Equally necessary are comparable reviews of such areas as equipment replacement procedures (stocking, ordering, etc.); inventory control and production scheduling, including storage and shipping facilities; materials handling procedures and facilities—all of which offer opportunities for significant cost reductions from up-to-date methods and equipment.

Nevertheless, the process itself remains a vital part of both the operation and a plant modernization program. We propose the process survey as a means of combating process obsolescence and maintaining the process at the optimum efficiency currently attainable.

The yield of a process modernization should be: (1) decreased unit costs; (2) improved product quality and reliability; (3) increased process versatility through the ability to produce more variations of a given product and to allow more variations in production scheduling to meet varying demands; and (4) an incidental capacity increase.

L. A. McClaine

E. Schrier

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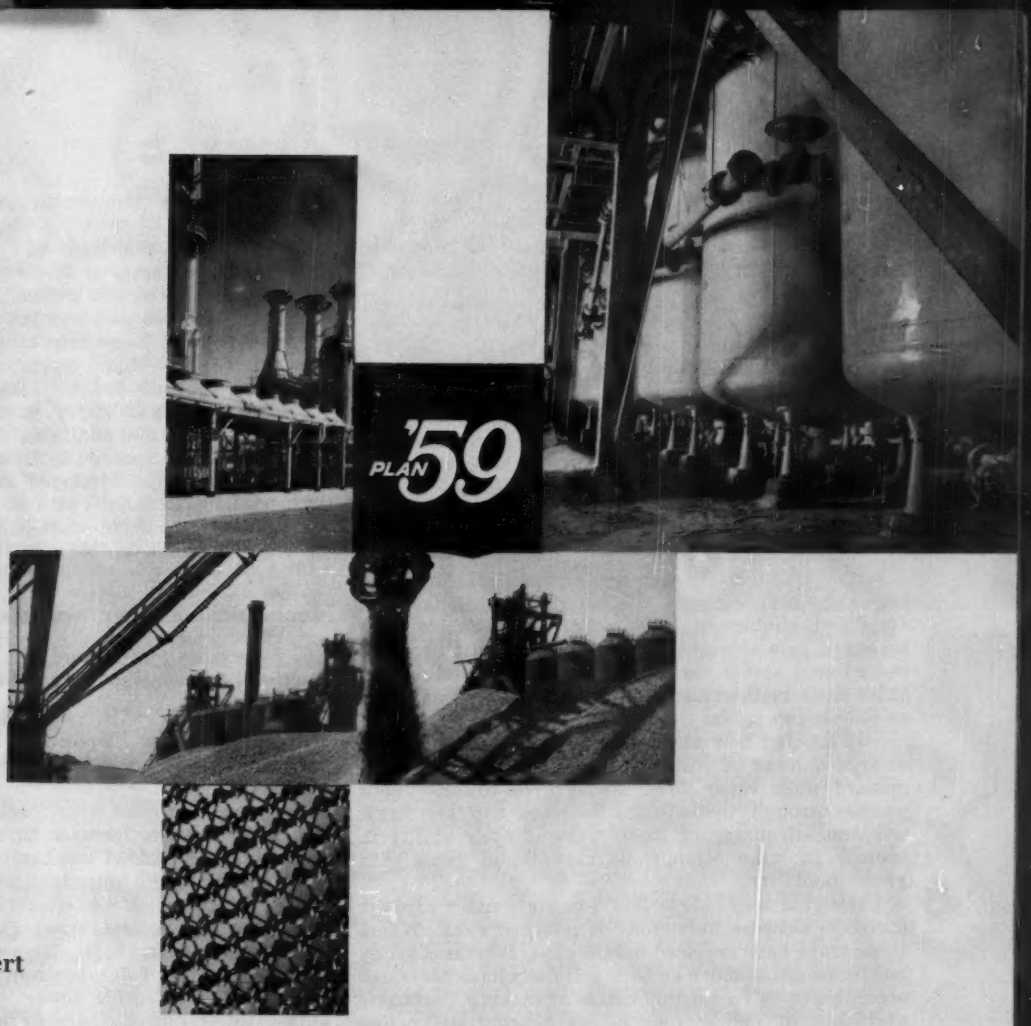


Plan now to convert

today's equipment

developments into tomorrow's chemical profits.

New Equipment Spurs Process Progress

In the next eight pages our engineering practice editors summarize and interpret the impact of new equipment developments on the modernization of 16 important chemical engineering operations.

Their assignment was to answer this specific question: What will new developments in process equipment mean in the modernization of chemical process plants? Using their own extensive engineering experience, literature search, long-distance telephone calls and their personal contact files, they have assembled this up-to-date guide covering these major areas:

- Distillation; evaporation; extraction.
- Centrifugation; crystallization; filtration.
- Ion exchange; adsorption and dialysis.
- Heat exchange; drying.
- Selecting materials of construction.
- Mixing; size reduction and agglomeration.
- Materials handling; fluids handling.
- Computation; instrumentation.

How can you make the best use of this guide? In the next five years we estimate that U. S. industry will pump about $20 billion each year into bringing its plants up to par. As a chemical engineer you'll be asked to direct equipment expenditures as the chemical process industries spend their share of that $20 billion in 1959, the next year, and the next year, and the year after that.

Consider the two-thirds of your plant equipment that is now more than 10 years old. Should you continue to operate this equipment with its built-in low efficiencies, high operation and maintenance costs and the overhanging threat of process slowdown or mechanical breakdown? Should you keep on using the equipment you now own, just because—like Mt. Everest—it stands there as a constant challenge?

Or shouldn't you consider how you might modernize now? Here's how you can turn today's equipment developments into tomorrow's profits.

More Variety in the Distillation Diet

New trays and packings accentuate the economic appeal of revamped design for towers and internals.

Chemical engineers have at their disposal several new distilling tower trays and packings. Today, you can select from the new menu as well as from the traditional old standbys—the bubble-cap tray and irregular-lump packed towers.

The sieve or perforated tray has been revived in applications where tray spacings are as low as 2.5 in. It's reported that perforated trays can be loaded more than bubble-cap trays, have higher efficiencies, cost about one-fourth less, have 10-40% more capacity than the same size bubble-cap trays and operate with about 80% of the pressure drop.

Ripple trays, with sinusoidal waves built into the tray are newer versions of sieve trays. Uniflux trays (modified bubble-cap trays with vapor bubble slots arranged in a straight row) use vapor action to help move liquid across the tray; they are lightweight, require little maintenance and cost about half as much as bubble-cap trays.

Still another new design is the Flexitray, which has a large number of restrained floating caps that move upward when vapor flows through the tower. Vapor passes through the annulus between cap and tray. Greatest advantage of these trays is their ability to operate in large columns at high liquid rates with great flexibility.

Turbogrid trays allow liquid-vapor contact through openings between bars, rods or punched slots. Where these trays have replaced bubble caps, column capacity has increased as much as 50% and costs have decreased accordingly. A recent innovation of making Turbogrid units out of hollow rods allows heating or cooling media to be circulated through each tray, thereby controlling the tray temperature without diluting the process stream.

NEW FLEXITRAYS (5½-ft. dia. above) with floating caps have high efficiencies at high throughputs. (Koch Eng.)

There's been a multitude of different shapes, materials, sizes and names of tower packing introduced in the last few years. In general, advantageous characteristics of these packings are: low weight/volume; low cost/volume; large free cross-section; large surface/volume; low liquid holdup; and good corrosion resistance, thermal and mechanical stabilities.

Finally, there is an improvement in distillation technique that might find additional devotees among chemical engineers. Spence & Green Chemical Co. of Crosby, Texas, has developed and now uses a novel horizontal fractionator (with no trays or packing) to separate heat-sensitive, close-boiling tall oil fractions (*Chem. Eng.*, Feb. 10, 1958, p. 76).

Mechanical Energy Speeds Extraction

To pep up your liquid-liquid or solid-liquid extractions, add some mechanical energy.

Liquid-Liquid—With recent development of highly efficient equipment, liquid-liquid extraction becomes more important than ever as a technique for separation by mass transfer.

Compared with the usual packed or spray columns, the newer designs increase turbulence and speed up mass transfer. Added mechanical energy is the key.

For example, one important design is Shell Development's rotating disk contactor (RDC). This contactor consists of a vertical tower fitted with a centrally mounted rotating shaft. Disposed vertically on the shaft is a series of flat, horizontal disks. Stator rings, attached to the inside tower wall, midway between adjacent disks, form separate compartments for liquid-liquid contact.

Degree of dispersion is controlled by disk design and shaft speed. No emulsions form and no interstage settling is required. Result is a low-cost countercurrent extractor with high capacity and good flexibility.

The Scheibel column is similar in design to Shell's RDC—it also uses a rotating agitator. But a recent improvement makes this extractor more valuable.

Original design called for a series of agitators mounted on a vertical shaft, with wire-mesh sections between the agitators. The wire mesh acted as settling zones, breaking up any emulsions. York Process Equipment Corp.'s new design has baffles around the agitator blades. This shortens the flow pattern and permits larger column diameters with low HETS values.

Out of work in the atomic-energy program has come the pulse column, a design which depends on the action of a pulsator to improve agitation in the extraction column. The pulsator transmits energy to the liquid mixture. It can be a piston, a bellows pump or a reciprocating pump.

One major advantage of the pulse column: You can use your present packed column (sieve-plate columns must have low clearances between plate and shell) and simply install a pulsing unit.

In any modernization program, don't forget centrifugal extractors (Podbielniak, Luwesta, Sharples). They have the advantages of compactness, high throughputs and low solvent inventories. Podbielniaks

are becoming very popular in lube oil refining, where they are replacing packed and sieve-plate columns.

Solid-Liquid—For extraction of solids there are a number of novel designs worked out for uranium recovery from ores, all based on the mixer-settler idea (*Chem. Eng.*, Nov. 1957, p. 251).

The usual mixer-settler consists of a baffled mixing tank with a turbine agitator for contacting solvent and feed. Mixed phases go to a settling tank. In many cases where such units have to be cascaded, the installation can get bulky and expensive.

One modification uses a pump to contact slurry and solvent. Mixed phases still go to a settling tank; but this technique eliminates the large mixing vessels and almost any centrifugal pump can be used.

However, not all the recent developments in solid-liquid extraction come from work on uranium. Allis-Chalmers has a countercurrent flow column in which solids settle down against an upward flow of solvent. Available in sizes up to 84-in. dia., flow of solids is regulated by a series of flow plates equipped with rotating scraper arms. The scraper arm on each plate moves solids through an opening in the plate down to a lower level.

Big advantage is that many batch solid-liquid extractions can be converted to continuous operation with the A-C column.

Evaporation Gets Fresh Approach

Units that pour out fresh water from the seven seas and submerged combustion lead advances.

Big new use lately for stationary evaporators has been to get "fresh water" (anywhere from 1 to 100 ppm. solids) from the briny waters of the seven seas (30,000 to 40,000 ppm. solids). The principles of vapor recompression, flash vaporization and multi-effect evaporation have formed the bases of today's working plants.

A novel design, though, is that of Westinghouse Electric International Corp. They stack four flash evaporators in a single tower and claim that this arrangement costs 30% less and takes up 80% less ground area than equal-capacity, submerged-coil evaporators.

Equipment for recompressing vapors has been improved so that lower temperature differences between condenser and evaporator can give very effective and efficient evaporation. Particularly, improved designs of rotary positive displacement and centrifugal or axial flow compressors have helped in this service.

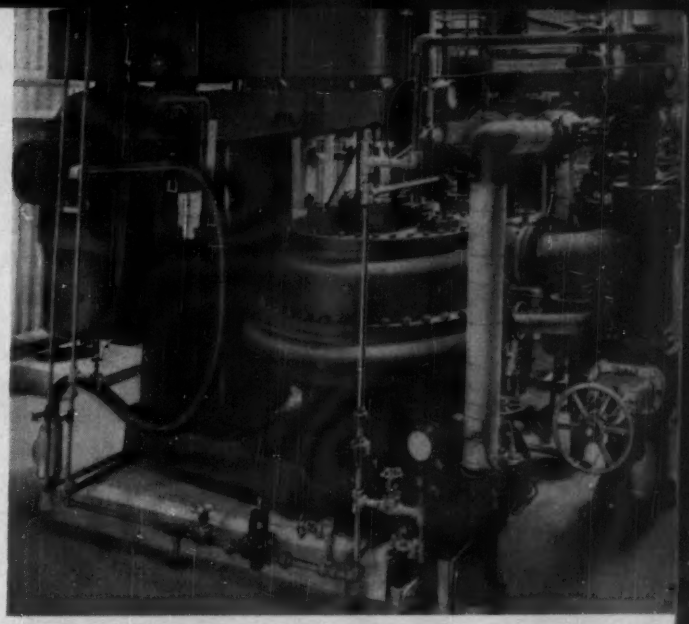
A new "continuous regenerative" evaporation process is now available. Feed liquor is preheated in series heaters, then vapor flashes from the liquor in a series of flash evaporators at progressively lower pressures, with the last effect connected to a barometric condenser. The vapors are then recycled to be reused in the heaters. As many as ten flash stages are used (Goslin-Birmingham Mfg. Co.).

Various film-type evaporators have come into process use recently. Typical of these are the Turba-Film (Rodney Hunt Machine Co.) and the Rotovak (Buflovak Equipment Div. of Blaw-Knox Co.).

Basically these units have revolving agitator blades which spread a thin film of turbulent liquid on the heated surface where evaporation occurs. The Versator (Cornell Machine Co.) gives very rapid evaporation from a thin film spread by centrifugal action.

The Buflovak Equipment Div. of Blaw-Knox has designed and built a gas-fired NaOH evaporator in which hot combustion gases from an external burner transfer heat across a bank of finned tubes to the liquor in a natural-circulation effect.

Submerged combustion or direct-contact heat transfer (where a flame burns underneath a liquid surface) is being adapted to evaporation operations. So far the major materials processed have been scale-forming or corrosive inorganic chemicals—sulfuric, hydrochloric and phosphoric acids, caustic and calcium chloride.



LATEST CENTRIFUGES, shown here in a polyethylene plant, can operate at pressures above 100 psig. (Dorr-Oliver)

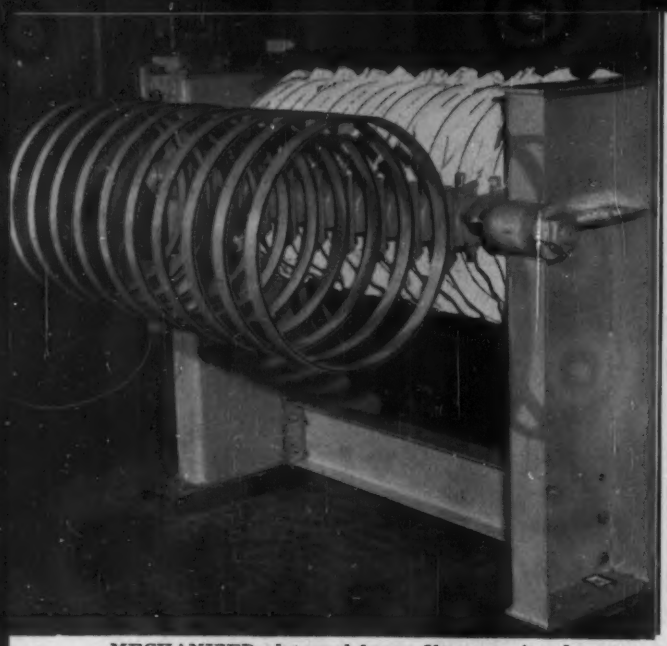
Pressure Put on Centrifugation

Manufacturers are in a race to build new centrifuges for operation under pressure.

Most noteworthy of equipment recently introduced for centrifugal operations is the pressure centrifuge. Until about two years ago, there were essentially no machines available for processing at pressures much above 1 atm.

Since then, however, several manufacturers have entered the high-pressure race, and it is probable that more will follow. To date, top standard working pressures have been held to roughly 10 atm., probably by seal and housing-strength limitations. Chances are, though, that higher-pressure units are in the works for the near future.

Much attention is being given to improvement of accessories and automation of batch units. For example, automatic operation of one batch-type unit depends in part upon a novel discharger shoe that remains in the basket at all times. This plow-like part assumes a trailing position during cake buildup; then direction of basket rotation reverses and at slower speeds the shoe removes centrifuged material. There is a minimum of degradation and no leftover heel.



MECHANIZED plate-and-frame filter permits almost continuous operation, has paired sets of frames. (Eimco)

Filtration Covets Continuity

Tilting pans, endless belts, pressure leafs and mechanized plates-and-frames all strive for the goal of truly continuous filtration operations.

Recent trends in filtration equipment indicate primary attention to continuous operation, new materials of construction and improvement of filter media and auxiliaries.

Now offered by several manufacturers, an important new equipment item is the tilting-pan filter. These machines are lately receiving widespread acceptance for operations where filtrate dilution is unacceptable. Also designed for filtration of coarse materials and slimy solids, these continuous horizontal units offer the possibility of truly segregated countercurrent washing.

Somewhat similar in concept to the spring or cord discharge filter, another fairly recent development is the continuous-belt filter. This unit has a filter medium consisting of an endless belt, either perforated stainless steel or fabric, that first passes over a discharge roll, then down through a washing trough for cleaning and finally back over the vacuum drum for cake pickup and dewatering.

Leaf pressure filtration has of late come into renewed competition with continuous, rotary vacuum filters. The same is true for at least one plate-and-frame press. Both developments are primarily a result of the manufacturer's success in partial automation or mechanization of these batch operations.

For solids that are sufficiently free-filtering to deposit a normal leaf cake, one leaf pressure filter now available features a pressure indicator that controls operation as a function of cake thickness.

Key to time-saving operation of the mechanized plate-and-frame press is its duplicate-frame construction. Two paired sets of frames are mounted at an angle of 180 deg. to each other on a single, motor-driven shaft. Thus, one set of frames can rotate out of the filtration line while a clean set goes in. This arrangement mechanizes operation to such an extent that two men can run three 30-frame presses.

Crystallization Stresses Close Control

More instrumentation is being called for on most of today's crystallization operations.

Forced-circulation crystallizers are the work horses of today's crystallization operations and should usually be thought of first in any modernization move.

However, agitated-tank crystallizers are still useful for comparatively small-scale production. They can be used to obtain excellent product at low first cost.

For example, Glauber's salt is crystallized from brine by one producer in continuous tanks equipped with highly polished stainless steel cooling coils. A series of vertical tube bundles is inserted into the tank and vigorous agitation is supplied. User claims the period between washouts can be extended from two days to six days because of the polished coils.

Modern crystallization equipment now provides accurate temperature control; flow rate and liquid-level control; and, if possible, concentration control. This is the minimum instrumentation required today.

To achieve this, forced-circulation crystallizers are being designed for low-pressure-drop (6 to 15 ft. of flowing fluid) circulation systems, using slow-speed, low-head, high-capacity pumps.

By adding external classification and a sludge-return system to the normal forced-circulation unit, the pachuca-type growth crystallizers have been developed to handle problems involving extreme salting or scaling. Although first costs are higher than conventional forced-circulation units, growth crystallizers are now being justified for many operations today.

For special problems, mechanical crystallizers such as scraped-surface Votator units are finding favor. These units provide rapid cooling and have small liquor holdup. However, capacity is necessarily smaller than conventional crystallizers.

Wanted: A Best Dryer for Each Situation

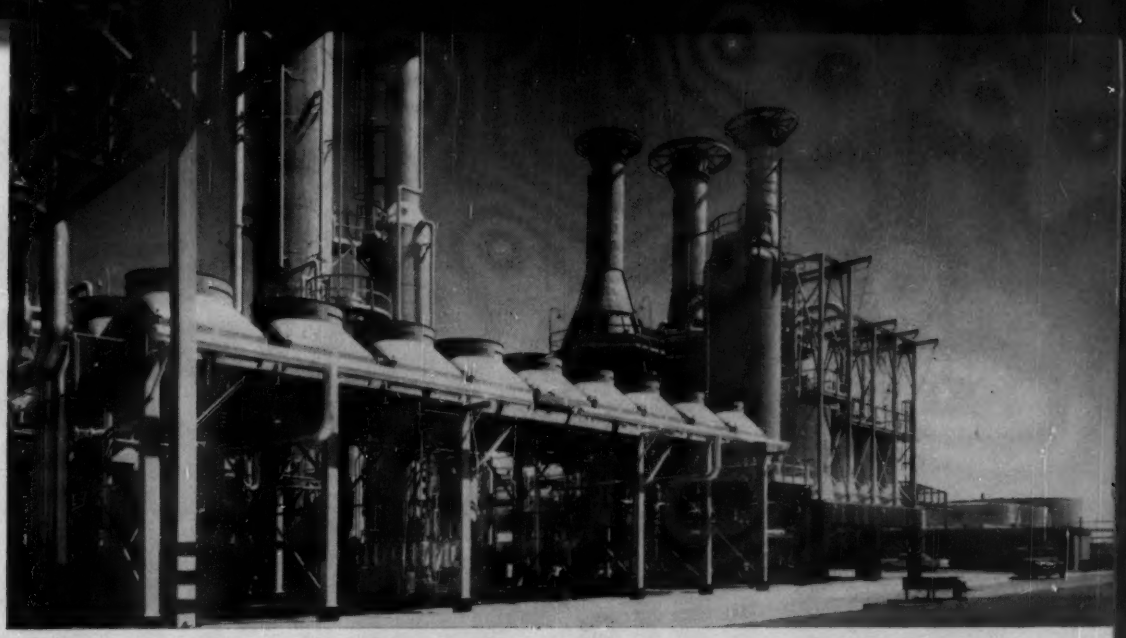
In general, there's been a growing awareness of a "best" dryer for each situation. Manufacturers have led the way by expanding their lines.

Now in the development stage, but still worth your watchful attention is the jet spray dryer. Here, extremely small particles are produced, drying time is much less than in conventional equipment and the units are much smaller. Jet spray dryers are especially suited for heat-sensitive materials with readily removable moisture.

Heat-sensitive materials that require longer retention times—such as plastics—are finding the fluid-bed dryer helpful. In some cases, even replacement of existing dryers has been justified.

Here are some other new items on the equipment scene that make replacement and modernization attractive:

• A new vacuum-dryer tray-rack design (Devine Mfg. Co.) ups capacity 25%. Savings this large are made possible by reducing downtime 50%. While one rack loaded with moist product rolls in, an extra rack and its load of trays containing dried product



ECONOMICAL AIR-COOLED heat exchangers are rapidly moving into chemical and refinery processes, replacing high-maintenance water-cooled equipment for 140 F. service and above. (Hudson Eng.)

rolls away. This permits operators to unload and reload the extra rack while the dryer is in operation.

• Positive displacement of fine powder through a controlled drying enviroment without dust loss is the job of the new Turbo-Dryer. Wyssmont Co. claims that this dryer with a tilting-tray device will cut your powder blow-away losses.

• A new horizontal spray dryer (Henszey Co., Watertown, Wis.) continuously assures a highly uniform product. This new dryer is offered as a complete package—controls, burners, auxiliaries, electrical work—all assembled and tested.

Heat Exchange Surges to Air Cooling

Outstanding trend in heat exchange is the grass roots movement to jump on the air-cooling bandwagon.

A noted consultant on heat-transfer equipment gave the 2nd National Heat Transfer Conference this summer these rules-of-thumb for the modern design of heat exchangers:

• If you have water available, then you should use air-cooled exchangers down to, say, 140 F. and use water cooling the rest of the way.

• Without a good low-cost water supply, optimum design calls for the use of air-cooled exchangers all the way down to 125 F.

Although some engineers are wary of the design problems encountered in the distribution of air flow across tube banks—complicated by the changing density of the flowing air as it heats up—modernized design calls for the elimination, wherever possible, of water cooling.

For service up to 700 F., here's a new idea. One of the latest British developments is a system in which heat is transferred by means of a medium which is solid at room temperature and into which a solvent is incorporated on cooling in order to maintain the liquid phase.

Other outstanding news in heat-exchange equipment comes from Oak Ridge National Laboratory. Using a vortex tube, chemical engineers have attained heat fluxes as high as 55 million Btu./(hr., sq. ft.) in the boiling of water. Key to these high heat fluxes is a new heat-transfer mechanism due to the helical flow pattern.

Ion Exchange, Adsorption, Dialysis

Moving beds make the grade in Wyoming. Molecular sieves ban oxygen. Dialysis sweetens water.

News was made this year by the first U. S. installation of continuous moving-bed ion exchange equipment. R. R. Porter's system, previously successful in South Africa and Canada is now in operation at Lucky Mc Uranium Corp.'s mill at Riverton, Wyo.

It's claimed that the moving beds are on stream 93% of the time and recover daily 2.0 lb. of U_3O_8/cu. ft. of resin used. This is twice the recovery of similar fixed-bed units (*Chem. Eng.*, Sept. 22, 1958, p. 80).

Also, this is the year of the first fulfillment of molecular sieves' brightest potential in adsorption equipment—separation of materials on the basis of molecular size. Linde Co. announced that for the past four years they have been quietly using their synthetic zeolite adsorbent at a major Eastern oxygen plant to remove residual oxygen from argon.

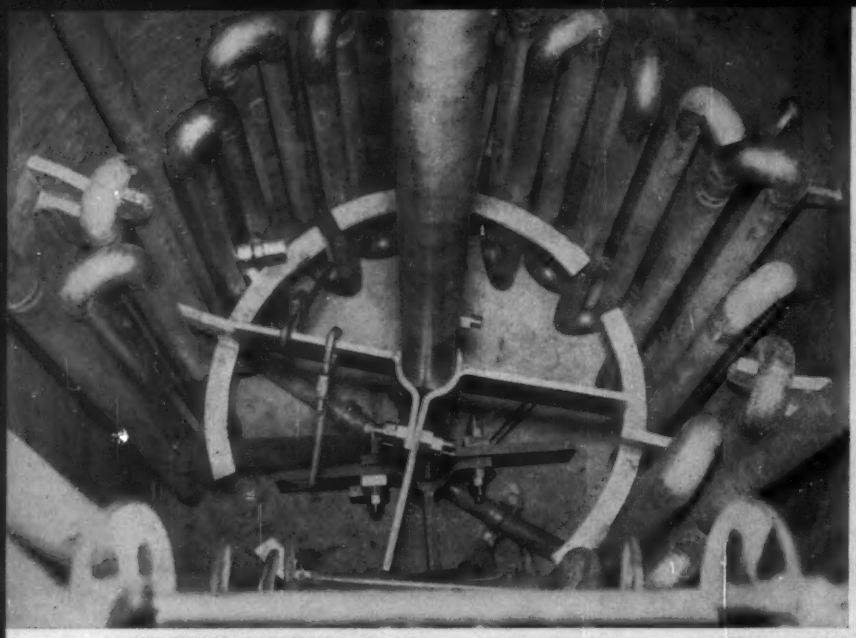
Large-scale electrodialysis is also scheduled for a commercial tryout this year. In South Africa's gold fields some 3.6 million gal./day of urgently needed fresh water will pour from 272,000 sq. ft. of parchmentized paper membranes.

Selecting Materials of Construction

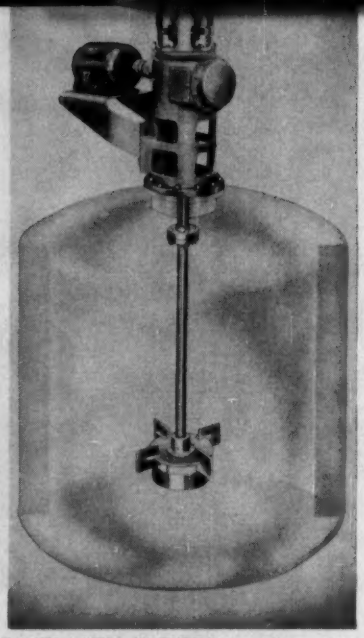
Great strides have been taken in the development of new materials for you to chose from.

Manufacturers of materials of construction have outdone themselves in the last few years. They've come up with a host of new and improved metals and nonmetallics.

For instance, take the stainless steels. Chromium-



TITANIUM HAIRPIN coil replaces stainless in HNO_3 service. Higher initial cost of titanium is more than offset by longer life. (Crucible Steel)



PACKAGED MIXERS avoid custom design costs. (Mixing Equip.)

nickel steels—widly used in the chemical process industries—have relatively low yield strengths, which can be improved only by cold working. New precipitation-hardened steels, originally developed for aircraft, can be strengthened by simple heat treating. As such, PH steels have a future in high-pressure reactors, etc.

In the low-temperature range an improved metal, which doesn't become extremely brittle at low temperatures, is available. This is 9% Ni steel.

We should also mention at this point, the development of Nionel alloy (40% Ni, 21% Cr) which has excellent resistance to severe oxidizing and reducing conditions—at reasonable cost. Also, ductile austenitic iron is available with strength and ductility approaching that of cast iron, and with the corrosion resistance of austenitic irons. This material is proving particularly valuable in pump cases and impellers.

Even wrought iron has been improved. A new iron is much more resistant to corrosives than the standard material.

Titanium is still expensive. But its excellent resistance to corrosion can more than pay for the high initial cost, in many cases. Zirconium is another "uncommon" metal now available in commercial quantities. With excellent resistance to HCl, Zr has been fabricated into heat exchangers, valve stems and reactors.

The attraction of aluminum as a material of construction has been recently marked by improvement in welding techniques. For copper-alloy construction, a major problem—stress corrosion—has been solved, at least for aluminum bronzes.

In nonmetallics, the missile and rocket field provides an unusual application for plastics. They're used in high-temperature service. Phenolics reinforced with silica or glass stand up to temperatures as high as 10,000 F. for short periods of time—something no metal can do.

An insulating char forms on the plastic surface, protecting underlying layers. Of course, plastics in missiles and rockets are only one highlight of dramatic recent advances. More and more reputable manufacturers are coming into the field of fabricating plastic piping and chemical equipment. Now you can buy well-engineered equipment—something you couldn't always do a few years ago.

Pfaudler has developed a new glassed steel with improved thermal shock resistance. Corning Glass offers Pyroceram, a new ceramic from glass. It's light, hard, tough and temperature resistant. It's also nonporous and available in many shapes, including tubing.

And in looking for better materials of construction, don't forget the fluorocarbon plastics. Du Pont has developed an extrudable form of Teflon which appears to be a valuable lining material for piping, valves and vessels.

Mixing, Size Reduction, Agglomeration

Here are the new ideas in equipment for mixing up materials, making them smaller, or larger.

In today's chemical plant, agitation systems may cost as much as 5% of the total plant cost. These systems may have annual maintenance charges averaging 20% of installed cost.

Therefore the user must not only keep in mind the design features of the equipment but also the ease of maintenance, accessibility of component parts, ease of assembly and disassembly, availability and storage of spare parts for repairs.

In the past many mixers and agitators were custom-designed—by either the user or fabricator. In recent years some manufacturers are supplying complete assemblies. This saves in these ways:

- Decreased design time required.
- Decreased equipment costs through production of standard components.
- Decreased installation costs through pre-assembly.

Biggest single news in size reduction seems to be Allis-Chalmers' horizontal vibrating mill. In operation,

a high-frequency vibrating unit applies rapid rotary oscillation to the grinding chamber about its center vertical axis. High-frequency vibration is imparted to the grinding medium.

This unit gives an accurate control of particle size, needs low power, small floor space and gives a long grinding-ball life.

On the other side of the fence, there's been an interesting development in agglomeration. Allis-Chalmers Mfg. Co. has a new mechanical compacting scheme that takes off-grade, dusty materials and steps them up in size to marketable products.

A-C's scheme takes fines and feeds them to a compacting mill where they're squeezed into a continuous sheet. This sheet is broken into chunks and then granulated to marketable mesh in a roller mill.

How to Handle Fluids and Materials

Long pipelines for hauling slurries are working well now. Materials handling is an area in your plant that's ripe for modernization.

Now the use of pipelines for handling slurries has been successfully demonstrated.

In one application, a 6-in., 72-mile pipeline carries gilsonite over mountainous terrain for delivery to the refinery. Another application is the successful operation of a 10¾-in., 108-mile pipeline for carrying pulverized coal to an electric utility in Cleveland. The coal-water slurry is separated mechanically from the water and the utility pre-dries the coal before it goes under the boilers.

In both of these cases, substantial savings are possible over other forms of transportation available at the respective locations.

Cost reductions are possible in the chemical process industries by using higher speeds in handling large volumes of gases or vapors. Centrifugal compressor speeds over 20,000 rpm. are common today. In some applications, gas turbines driving turbocompressors furnish the major part of process heat requirements from the hot exhaust gases of the turbine.

Especially in refinery operations, we find the high-speed reciprocating pump re-entering the field of fluids handling. Currently available are pumps designed to handle corrosive materials. These include:

- Glassed-steel pumps to handle all organic and inorganic acids except hydrofluoric and alkalis up to pH of 12 at 212 F. One drawback, however, is that glassed-steel parts can not stand sudden mechanical impact.
- A Hypalon liner for diaphragm pumps allows handling of corrosive liquids and gives relatively longer life before replacement of the diaphragm is necessary.
- Canned pumps handling liquid metals at operating temperatures up to 1,600 F. and at flow rates up to 5,000 gpm. are finding increasing use around nuclear reactors.

Interesting sidelight in fluids handling is the introduction of color-coded nylon tubing for use in instrument air control. A 50% cost reduction is indicated over copper tubing.

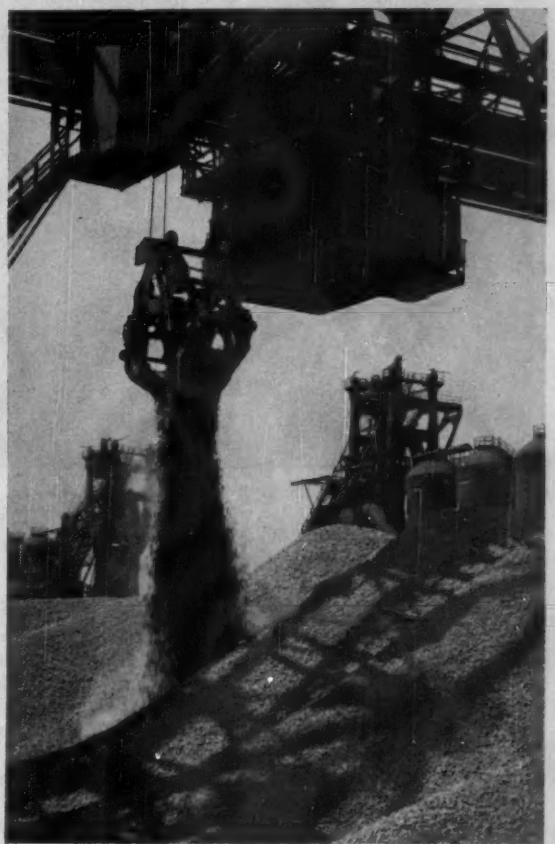
Materials handling is one of the major areas of your plant that's ripe for a good modernization program. Everyone's beating the drum today for bulk handling.

To help you unload light, granular solids, Sprout-Waldron has developed a bulk truck-carrier with built-in pneumatic handling system. These trucks load themselves from either storage bins or railroad cars. Then, at their destination, they can unload themselves as well.

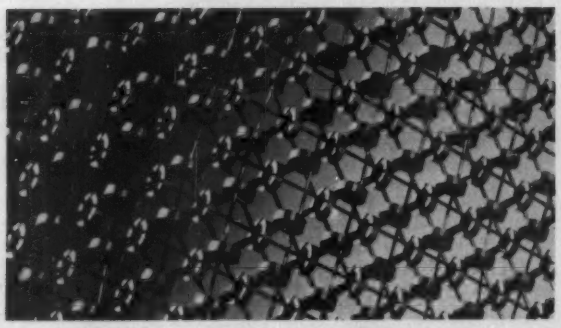
Another new technique that is making headway is shipment of dry solids in tankcars. A number of chemical firms are doing this today.

Of late, pneumatic conveying has come in for a few surprises. Many materials tend to smear or "ribbon" on the inside of conveyor pipes. Fuller Co.'s Dracco Div. has announced some startling results. Instead of the logical procedure of using smooth pipes for these difficult materials, they've found that sandblasting to roughen the surface works extremely well. To date, nearly a dozen polyethylene producers have adopted this technique.

In the line of more conventional conveying equipment, Denver Equipment Co. has a belt conveyor that doubles as a solids classifier. Solids are separated according to particle size in a pool held by a trough in the belt at one end of the conveyor.



MODERN BULK handling, including large-scale conveying, is a key factor in many modernization programs.



HIGH-SPEED DIGITAL computers (704 below) feature new memory unit with 140,000 magnetic cores (above). A stored number is available in 12×10^{-6} sec. (IBM)

Electronic Computation Comes of Age

Now computer manufacturers are building machines especially for engineering use.

The computer center director for one of the largest companies in the process industries has divided the areas of computer usage into these five classes:

1. *Operations Simulation*—Economic studies to optimize yields in over-all operations.
2. *Process Design*—Day-to-day engineering design calculations.
3. *Process Dynamics Control*—Automatic data logging, operating-guide computation.
4. *Pure Research*—Studies in reaction kinetics, thermodynamics, etc.
5. *Information Retrieval*—Classification and access to large volumes of technical data.

Without making a detailed inventory of all the hardware now available to the engineer, here are some of the more recent advances.

In analog computers, electronic amplifiers and components are replacing the wheels and the disks. Therefore, more accuracy can be built in. Generally, analog units are very satisfactory for solving certain classes of equations, such as those that involve differentials and time variations.

Latest advance in digital hardware include transistorized components, which reduce power and cooling requirements. Over-all speed of operation, memory or storage capacity and speed of access to the storage unit have all been greatly increased by several orders of magnitude.

Applications of computers to process control are just being tried, though no on-line computer-controller has reached the commercial application stage. Most work so far has been directed toward computation of operation guides, data logging, instrument monitoring and other sideline operations.

Though computers are now used successfully to schedule and control certain mechanical operations on the assembly line or to plan, program or initiate and regulate rocket and missile tests, there's more process information needed before computers may be entrusted to sole, absolute decision making in chemical operations. The day will come, though.

Big News Is In-Stream Instrumentation

Instrumentation is now ready to solve the problem of assured product quality.

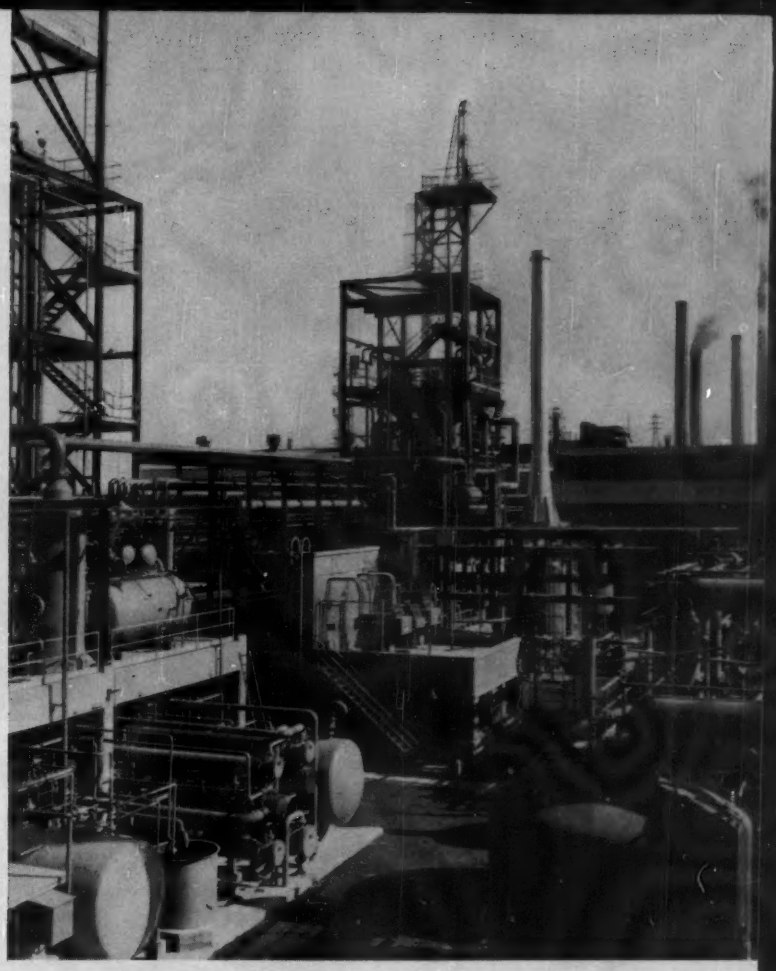
Outstanding instrumentation development of the past few years is the increasing use of in-stream process analyzers in chemical operations. These include methods such as infrared, mass spectrometery, vapor chromotography and radio-frequency spectroscopy.

Basically, the in-stream analyzers provide continuous information on product quality. Hence the operator now can reset controls in several related systems if necessary to produce the optimum product.

Although in-stream analyzers are priced in the tens of thousands of dollars, an increase of only a few percent in yield or product quality in continuous process plants more than pays for the equipment in a relatively short time.

However, the in-stream analyzer does not retire all primary measuring devices for flow, temperature, pressure, etc.; and necessary equipment for primary measurement is being modified to provide continuous monitoring of specific variables and to provide continuous read-out either at the measuring point or at a remote point.

For flow measurements, radioisotope tracer techniques are the newest development. In practice, a solution of a radioactive salt is injected into the process stream and downstream Geiger counters interpret the flow. This technique can be used to measure flow rates in pipes without flow meters, to determine leak rates between cross streams and to measure liquid entrainment in distillation towers.



Updating outmoded equipment and processes pays off in many ways. Major companies tell how.

Five Cases for Modernization

1. Multiproduct Plant

Better use of personnel, equipment and real estate via thorough modernization of chlorine-based plants shows up in dollars and cents.

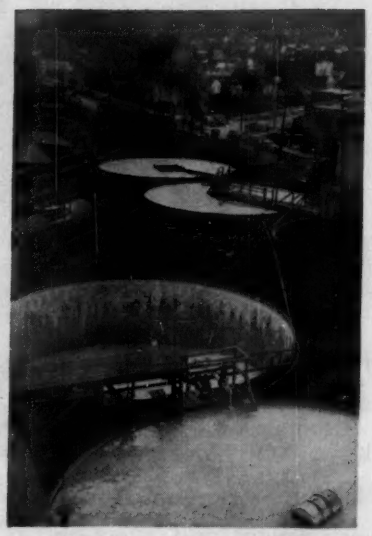
Revamp of key facilities at Food Machinery and Chemical Corp., Westvaco Chlor-Alkali Div.'s chlorine-based plant complex at South Charleston, W. Va., has yielded a 26% across-the-board reduction in personnel. At the same time, output and quality of products have been raised, and real estate and building space released for future use.

Modernizations and expansions thus far completed: A 460-ton/day chlorine plant accompanied by new brine treating facilities; a 200-ton/day carbon bisulfide plant; and a 100-ton/day carbon tetrachloride unit. Also, a 70-ton/day ammonia plant has been completed to upgrade byproduct hydrogen from the chlorine plant. This gas had previously been used as fuel.

Still underway: 1957 to 1962 program for streamlining the steam-power unit, whose 700,000-lb./hr. output of steam supplies about half the plant's electric power, as well as all its process steam needs.

Plant Starts 5-Yr. Program—Core chlorine unit of the plant complex, which FMC acquired in 1948, was started back in World War I and reached substantial size in the '30's. Matching the fabulous but Topsy-like growth of the whole chemical industry over those years, additional capacity and new products had been tacked on as new demands developed. Located near excellent rail and water transport, and within a 500-mile radius of chemical-industry concentrations, the site soon yielded chloral, caustic potash, bromine and ethylene dibromide, in addition to those products already mentioned.

Starting with this network of facilities built in stages over several decades, FMC tackled the job of updating and integrating the plant—not only equipment and processes, but also organization structure, technical strength, employee and community relations, and all the other factors that make for a sound plant. The results are now beginning to show, in both plant economics and a new "can-do" spirit.



CONTINUOUS brine treater (above) at FMC's modernized Westvaco Chlor-Alkali Div. now replaces outmoded batch brine tanks (right).

Key principles in the 5-yr. modernization program:

- Provide new processes where old ones were obsolete.
- Centralize controls with maximum automatic instrumentation.
- Convert batch operations to continuous when possible.
- Conserve land and building area.
- Substitute largest available equipment for a multiplicity of smaller units.
- Improve working conditions for all employees.
- Maintain maximum continuous production during these radical changes.

Changes in Bisulfide Unit—Westvaco began modernizing at the point of greatest need, the carbon bisulfide plant, where operating cost was exceeding sales price in 1953. The old unit consisted of 100 retorts, hand-fed and hand-controlled. It produced 75 tons/day and demanded a labor force of 110, mostly unskilled.

Begun in 1953 and expanded twice since, the new continuous plant, manned and maintained by 25 workers (most of them skilled), now makes 200 tons/day. Pipeline-fed by molten sulfur and methane, the process is highly automated.

Work area is now only about 75% that of the previous plant. Into the bargain, product quality went from commercial to as good as CP grade.

Cell Modernization Pays Off—About one-third of the entire modernization cost has gone into refurbished chlorine and brine treating facilities. Here, manpower requirements were cut 40%, production upped 30%.

In place of 5,000 small electrolytic cells of three different varieties producing only 360 tons/day of chlorine, 400 of the largest Hooker Type S-3 cells now turn out 460 tons/day. And only two of the original three cell buildings are now in use.

The new cells require less frequent reconditioning. More important, this reconditioning can be carried out by a single maintenance crew and a single set of facilities in one central building. Previously, the three cell types had been handled in three separate buildings.

Batch to Continuous—Once batch, the brine treating plant is now continuous, centralized in one area and centrally controlled. Brine is dosed with soda ash through the center well of a continuous Infilco settler to precipitate calcium and magnesium; then overflow is polish-filtered.

The old carbon tetrachloride unit was started in the '20's and operated at reasonably low cost. But by substituting highly instrumented continuous chlorination of carbon bisulfide, double the previous batch capacity is now produced with much less equipment and space. Byproduct sulfur is recovered and recycled to the carbon bisulfide plant, also by a Westvaco-designed continuous process. With one exception, all other carbon tetrachloride producers chlorinate methane, which yields byproduct HCl, sometimes a disposal problem.

Pulverized Coal on Way in—Still in progress is modernization of a steam plant that consists of seven 20- to 30-yr. old boilers. The chain-grate stoker boilers are being rebuilt so that cheaper pulverized coal can be used in all units. Air preheaters and fly-ash collectors are being installed where needed on older units. Thermal efficiency is up about 10% over the previous 70-75% range. And the new air-conditioned instrumentation room with centralized automatic combustion control will require fewer operators and present more pleasant working conditions.

Thus, FMC has capitalized on the cleaner, space-saving, larger-capacity process units, and at the same time has brought the whole plant more up-to-date by installing new personnel and public facilities: e.g. locker room, reception room, better-located air-conditioned operating offices, more paving, and liberal application of a color-coordinated painting scheme. As a result of this modernization program, indirect benefits are also showing up via boosts in both employee moral and company-community relations.

2. Multiprocess Plant

Programmed modernization of equipment and processes converts a 1943 batch GR-S plant into an up-to-date continuous facility for producing 18 different types of rubber products.

This fall, Goodrich-Gulf Chemicals, Inc., is winding up the final phases in its current program to retread a World War II GR-S (Government rubber—styrene) facility into a modern SBR (styrene-butadiene rubber) plant.

Since its $11-million purchase of the largest (122,000 long tons/yr.) American GR-S plant at Institute, W. Va., in February 1956, Goodrich-Gulf has added another $5 million in modernization to convert its speculation into a solid investment. In place of a defense-oriented 1943 facility, they now operate an up-to-date plant able to compete and, at times, even to lead the technological parade among synthetic rubber producers.

Operating for the government, Institute produced only three different types of rubber. Now, it turns out 18 different types in a number of different packages to suit individual customer preference. Included are nine types in both the "hot" and "cold" rubber varieties.

Much Is Hidden—Much of Goodrich-Gulf's modernization lies hidden among such upgrading steps as adoption of more stainless steel to improve product quality. Rubber producers, for instance, now make crumb rubber that is essentially pure white. And Goodrich-Gulf feels that its careful avoidance of metallic contamination contributes mightily toward the high quality of its white crumb.

Still More Is Visible—When you look for major evidence of where big chunks of Goodrich-Gulf's modernization money went, two projects stand out quite clearly.

Originally, their polymer plant was tied closely to a monomer facility, now owned by Union Carbide Chemicals Co. Utilities were located in the monomer section of the complex. These included a steam-generating plant, supplies of city water, raw river water, fire protection water, natural gas and power from the Appalachian Electric Power Co., through a substation operated by Carbide.

According to conditions specified at the time the government sold the monomer facility, Carbide had to furnish these utilities to the polymer plant until midyear 1957. Because its own growing demands for steam would eventually take full boiler output, Carbide could not offer to extend this deadline, except at prohibitive cost.

Thus, Goodrich-Gulf had to move fast to build its own steam plant. By June 1957, the company had completed and started up a $1.5-million steam plant containing two 50,000-lb./hr. boilers.

From Hot to Cold—During this same period, Goodrich-Gulf revamped one of the three hot polymerization lines to produce cold rubber (polymerized at 41 F.), and came on stream in January 1958.

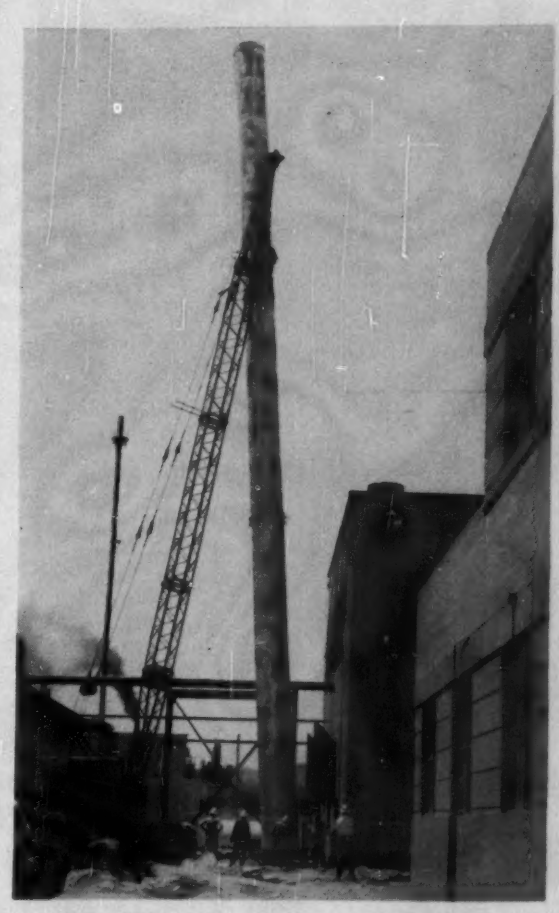
For the $2.5-million cost of this conversion, Goodrich-Gulf got a new 1,000-ton ammonia refrigeration system, together with all the piping linking it to the polymerization reactors' cooling coils (also part of the conversion).

Insulation for this large, low-temperature system consists of Foamglas blocks, taped, coated and covered with thin aluminum sheet. Kettle jackets became insulators with addition of ground-cork filling, while external insulation protects the tops of the reaction vessels.

From Batch to Continuous—In switching to cold polymerization, Goodrich-Gulf added piping, pumps and valves to convert batch reactors to a continuous-flow system. And, addition of feeders and controls for maintaining continuous-process conditions tied together the integrated process elements. Three new finishing reactors rounded out the system.

With the changeover to cold polymerization, they also added large makeup storage tanks, associated pumps and piping for handling rosin-acid soap.

In the same area, Goodrich-Gulf engineers installed a roller-conveyor storage rack for para-menthane hydroperoxide. Uphill end of the conveyor accepts incoming drums from the receiving platform. Drums for use



CONSTRUCTION crews erect one of the stacks for Goodrich-Gulf Chemicals' new 100,000-lb./hr. steam plant.

are withdrawn from the lower end, assuring that the oldest stock is used first.

New Look in Finishing—Improvements just being completed now will broaden the Goodrich-Gulf product lines.

A new extruder-dryer machine cuts drying time for rubber crumb from an hour to a few minutes. Using vacuum drying following intensive mechanical squeezing, the 8,000-lb./hr. machine reduces moisture content of crumb from 50% to less than ½% during one pass.

Product possesses a unique property of being partially "broken down" for compounding. Because much of the water is removed mechanically, soluble salts are carried away, producing lower-ash rubber. From an operating standpoint, the dryer can change from one type of rubber to another with little if any cleanup; maintenance is much less than for conventional conveyor-dryers.

A second modernization of finishing operations will be new equipment that produces crumb rubber in the form of discrete finished particles. Such granules will disperse with maximum ease in solvent when end use requires rubber solutions.

In operation, crumb leaving a conventional conveyor-dryer drops through a disintegrator for reduction to ⅛-¼-in. size before final cooling on a shaking cooler-conveyor. Talc, added through automatic proportioning equipment before disintegration and after cooling, keeps particles from agglomerating. Then automatic equipment weighs and packs the granules in fiber cases.

Still another innovation introduced during modernization is a machine that wraps baled rubber in polyethylene film, and heat-seals the wrapper. Since polyethylene is compatible with rubber, the user doesn't bother to unwrap the bale. He just mills the wrapped block.

Modernization to Continue—Final capstones in Goodrich-Gulf's modernization drive are the corporate Sales Service and New Product Development departments, recently relocated at Institute. Plant Mgr. Fred Hands looks to these groups to keep Goodrich-Gulf rubber products growing at a rate that will nurture continual modernization. And before long, they could spark reactivation and modernization of the third and final polymerization line in this, the largest synthetic rubber plant in the U. S.

PART of a recovery process, new stripping column goes up at Goodrich-Gulf's styrene-butadiene rubber plant.

3. Single-Process Plant (Inorganic)

Caught in the squeeze of fast-changing technology, Du Pont is revamping many of its sulfuric acid plants throughout the country. Here's how it brought a small 16-man acid plant up to date.

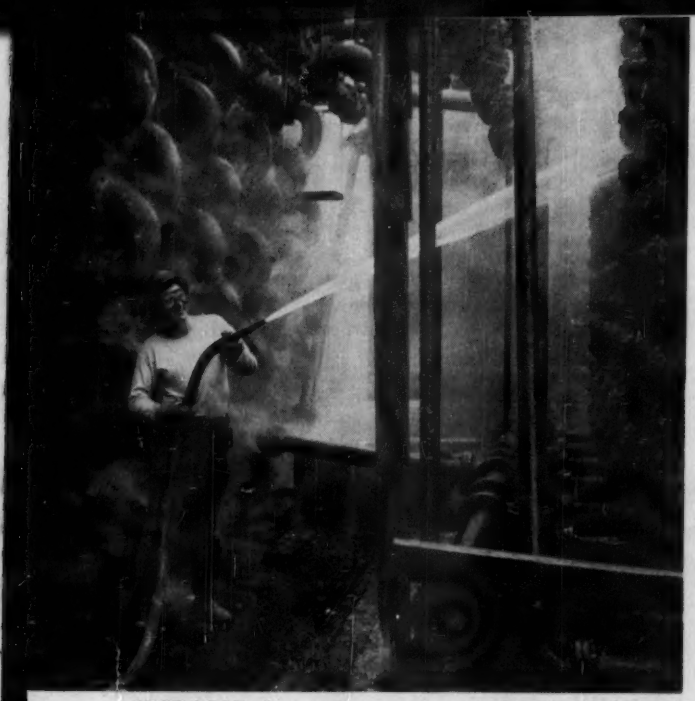
"More than 80% of Du Pont's construction in 1958 will be aimed at updating, modernizing or expanding the capacity of its existing plants," states a Du Pont source, underlining the major role of modernization in that firm's growth plans. Total bill for this streamlining project during 1958 will run over $200 million.

Typical of this extensive program is Du Pont's overhauling of its sulfuric acid facilities. Since 1947, seven plants throughout the country have been thoroughly revamped to keep pace with the ever-changing technology of the chemical industry. Latest of these to get the spruce-up treatment was the small 16-man Ecorse Works, eight miles south of Detroit.

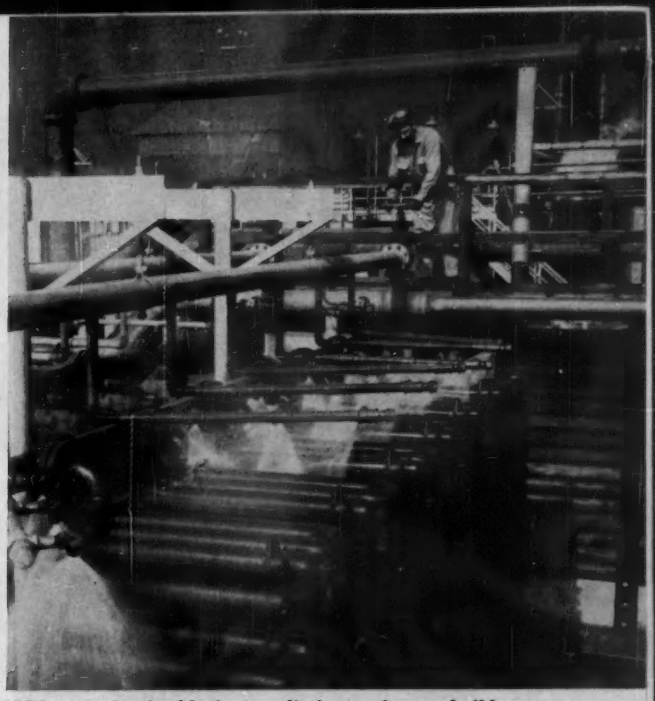
At this plant, Du Pont found itself with a 30-year-old contact sulfuric acid process. There was no centralized process control; many man-hours were spent tramping through the plant reading gages and "sticking" tanks. Quality was difficult to control in this outmoded unit because control points were so far apart. And operating costs were out of line with productivity.

Du Pont's remedy was drastic: The old unit was torn down and an entirely new facility erected in its place. The new plant, which went on stream early this year, was built around the Leonard-Monsanto contact process, and was engineered by Monsanto. Cost was "several million dollars"—six times more than the old unit cost. Now capacity is 300 tons/day—three times greater than the dismantled unit.

Main dividend reaped from modernization is the increased output with the same labor force, thus lowering operating cost per pound of product. Too, product



OPERATOR cleans process coolers at old Ecorse Works.



NOW, new plant's chlorinator eliminates fungus buildup.

quality was improved by centralizing process control at a single place. On the 18-ft. panelboard, 27 critical temperatures are indicated at the push of a button; 12 points are monitored continuously.

And not the least of the benefits at the new plant are the improved working conditions. All through the plant, many back-breaking and time-consuming chores have been replaced by less arduous—and more productive—tasks of operating automatic equipment and controls.

4. Single-Process Plant (Lube Oil)

Some modern equipment plus a new twist to an old process promises soon to cut operating costs, improve product quality and hike capacity at Shell's lube-oil refining facilities in Wood River, Ill.

Striking examples of expected benefits from modernization are those stemming from Shell Oil Co.'s extensive program now underway at its Wood River, Ill., lube-oil refining facilities. Completion is scheduled for next June.

Modernization, explains Shell, will not only boost over-all charge capacity by 50%, but will also hike lube-oil output by an impressive 100%.

What's more, Shell estimates that it saves roughly 50% in capital costs by modernizing instead of building a new plant from scratch.

Key Process Switch—Although Shell's entire program involves a number of major new units, simple modernization of one step—propane dewaxing—by itself adds a hefty 25% of the capacity boost.

Dewaxing also figures in the key process switch that helps mightily in doubling output: Extraction of aromatics in the new setup precedes dewaxing. In part, this profitable switch will be made possible by better processing earlier in the flow scheme—better fractionation of lube stock and vastly improved deasphalting (which means that no propane will be needed for aromatics extraction—see p. 54).

Before Revamp—Previous process scheme was this: Waxy oil feed entered the vacuum fractionator and split into four streams, including asphaltic bottoms. After the bottoms stream was deasphalted, the four lube stocks flowed to storage tanks to await further individual processing.

This consisted of propane dewaxing followed by removal of sludge-forming aromatics via Duo-Sol solvent extraction. In this two-solvent countercurrent process, propane and phenol-cresylic acid tied up and removed sludge formers. Finally, raffinate from the Duo-Sol step was clay-contacted to produce the finished lube-oil product.

Why Modernize?—When Shell began to think about expanding its operations, it uncovered an attractive array of new or improved processes. With these available, common sense directed modernization of some of the existing facilities rather than new construction.

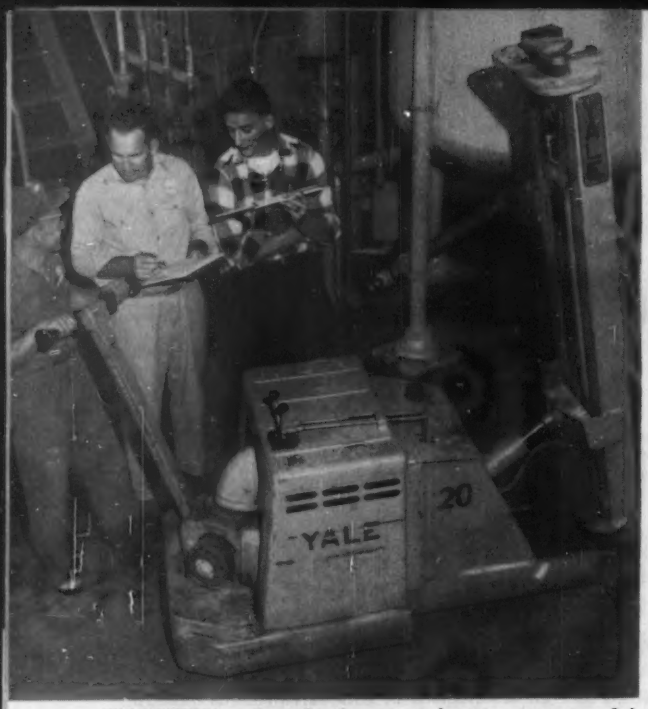
Furthermore, to dewax earlier in the process seemed, in the light of the newly available processes, especially alluring. Removal of aromatics after propane dewaxing meant that Shell was originally using more capacity than necessary to do the dewaxing job—aromatics were using up capacity, fouling the wax yield.

So Shell is switching these operations. Aromatics removal will come first—by phenol extraction in high-speed centrifugal extractors, not by Duo-Sol.

Less Water, More Propane—Chief equipment changes will be new units to remove troublesome water vapor, and to boost propane recovery capacity.

High-pressure and low-pressure desiccant drums (two at each pressure, 40 in. dia. by 40 in. high) are being added to remove water that had been crystallizing out, clogging heat exchangers and rotary wax filters. Also, use of nylon filter cloths instead of cotton media will improve filtration rate. And, a new kettle evaporator will add nearly 106,000 lb./hr. to propane recovery capacity. This unit will use 15-lb. steam to vaporize propane at about 260 psig.

Finally, further along in the process train, Shell is adding a new flash evaporator (spinning disk under vacuum) to remove last traces of moisture and light vapors.



ENGINEER and production supervisor team up to advise operator of the why's and how's of Baker's modernization.

5. Fine Chemicals Plant

"Where and how much should we modernize?" Teamwork between line organizations and a new staff industrial engineering group answers this question for the J. T. Baker Chemical Co.

About two years ago, the J. T. Baker Chemical Co. at Phillipsburg, N. J., decided to tackle the problem of cost reduction. Realizing that methods improvement by modernization was a means to this goal, Baker created a fully staffed Industrial Engineering Department (IED) to analyze and study processes and operations in close liaison with the line organizations. The philosophy of this approach, which involves active participation from all departments throughout the company, avoids an ivory-tower technique in which a single staff department analyzes problems and makes recommendations to top management.

Systematic Improvement Plan—Process by process, the manufacture of Baker's many different chemicals is undergoing systematic study. Prime targets for unit cost reduction are materials, labor and overhead. Weapons of attack include practical-methods analysis, process-labor time measurement, control techniques and, eventually, standardization of operating procedures.

Procedure standardization involves several steps. Production people, with the assistance of IED, first define a standard operating procedure for each existing process. Subsequent improvements in processing techniques are evaluated, economically justified when necessary, and ultimately incorporated into a revised standard operating procedure. This spells out economical material flow, process cycles, labor cycles, equipment utilization, production yield and production rate.

Operating cost standards are then drawn up, and variances from standard are monitored, checked and corrected. The end results are cost improvement and plant modernization.

Substantial Savings Follow—In the manufacture of one reagent-grade chemical, such a study led to the reapportionment of raw material feed. This saved more than $30,000 a year. It also increased production output by as much as 16%.

Similar studies aim at allocating and defining operating costs in the miscellaneous-chemicals department, which manufactures a wide variety of chemicals in versatile equipment. With better knowledge of these costs, the production of chemicals in specifically adapted equipment and layout units should produce substantial savings in labor, materials and overhead through elimination of bottlenecks, unnecessary steps, material waste and equipment idle time.

Enter Automation—In the packaging of miscellaneous reagent acids, another IED study showed that automation of the filling line was in order. Previously, these materials were hand-bottled with a syphon, hand-labeled and loaded into cases.

Now the bottles are machine-filled, machine-labeled and belt-conveyed to cases already stacked on pallets for transfer to storage. The change has reduced labor cost sharply and increased output tremendously. This modernization should pay for itself within a year.

Just recently completed and now on its way to fruition is a program leading to automation of liquid-chemicals handling. More than 200 different liquid chemicals were heretofore packaged manually and stored under one roof. An IED study proved the feasibility of constructing a new warehouse to store the packaged products, and of converting the existing building to an automatic filling-labeling-packaging line.

Construction crews have already started on the new warehouse; as soon as it is completed, the present building will undergo its transformation. The savings in labor and increase of output resulting from this modernization will more than meet the capital investment involved.

Still another program under study will most likely lead to the consolidation of servicing operations in a single building rather than in the scattered locations now being utilized. Equipment centralization, step-saving methods of materials handling and modernization of the facilities should result in lower costs, and should improve service to the manufacturing departments.

Gradually, IED studies will cover every phase of Baker's operation, with a goal of further modernization and still higher levels of plant efficiency.

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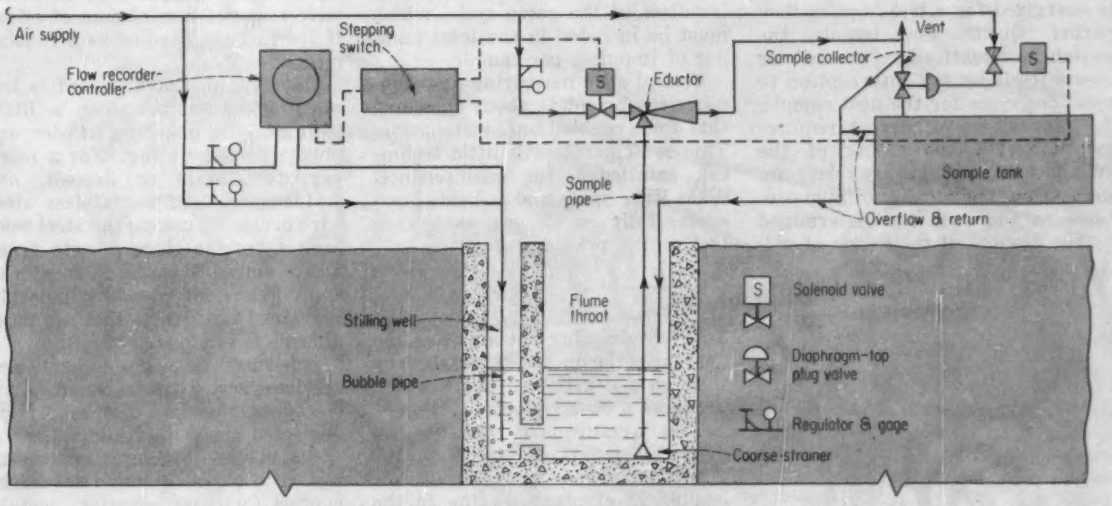


Avoid Trouble in Using Your Parshall Flume

This simple way of measuring and totalizing flow and taking proportional samples averts solids troubles in using a flume

John M. Crocker and Keith Campbell
Design Department, The Rust Engineering Co., Birmingham, Ala.

In a recent paper mill installation we had the problem of measuring and integrating a large flow and taking periodic samples, using a Parshall flume. The flowing material contained suspended solids which would tend to settle out in a stilling well of conventional type, and would harden on a float if we were to use that type of equipment. In either case a false reading would be obtained.

In addition to that, there is little space in the throat of a flume for a conventional cylinder-type sampler (so-called "rocket-launcher") and our solution averted that problem, too, along with the difficulties due to solids.

The instrumentation consists of two main parts: A level recorder calibrated in terms of flow, which integrates the flow and at stated flow increments sends an electrical signal to a stepping switch; and a sampling system operated by solenoid valves, actuated by signals from the stepping switch, which at intervals picks up a sample from the flume and then directs a measured volume of it to a sample tank.

In a Parshall flume the flow rate varies as the 3/2 power of the head of liquid in the flume throat. The flow recorder-controller used is a level instrument of the type which measures the back-pressure signal from a bubble pipe in the stilling well of the flume. The instrument records directly on a 3/2 power chart, thus eliminating the need for a costly instrument using cams.

The flow recorder-controller is sized and calibrated by using information from Bulletin 488, U. S. Department of Agriculture, Soil Conservation Service, "Improving the Distribution of Water to Farmers by Use of the Parshall Measuring Flume" (May 1945). Since the flow is recorded directly, it is a simple matter to integrate the flow in any convenient units.

The integrator is provided with contacts which send an electrical impulse for each pre-set flow increment to the stepping switch. The latter then controls the sampling setup which consists of an eductor, two solenoid air valves, two regulators and gages in the air system, a diaphragm-top plug valve and a small storage tank for the sample. These are piped up as shown in the diagram. In operation, a signal from the stepping switch actuates the first solenoid valve to supply air to the eductor, which then picks up a sample and recirculates it back to the flume. A second signal then actuates the second solenoid valve to put air pressure on the diaphragm-top plug valve, thus dumping the sample collected in a small section of sample pipe into the sample tank.

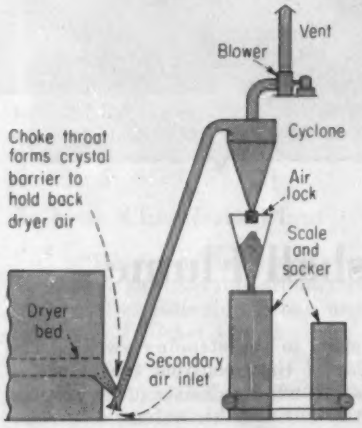
The stepping switch is indexed, from a starting point, by the pre-set flow increment mentioned above until the desired number of gallons between samples has been reached. At this point the switch operates the solenoid air valve on the eductor. By means of jumpers on the switch contacts the signal can be held for two inpulses (more or less, depending on the length of sample pipe) to hold the valve open.

After the eductor air valve has been de-energized, several impulses

are allowed to index the switch while the sample line is draining, except for the small sample caught in the sample collector. At that point the sample-dump plug valve is energized for a two-impulse flow period. On the next impulse the switch automatically "homes" or resets itself by self-interruption to reset the cycle for the next sample.

If the air-valve current requirements exceed the rating of the switch contacts, auxiliary relays are necessary. The number of step contacts on the switch is determined by the number of thousands of gallons desired between samples. The switch should be connected "early" for a given number of gallons between samples because of the other functions of the same switch, using impulses of the same cycle, which must be included in the total number of impulses per sample.

Cost of such measuring and sampling equipment is about one-third that for a conventional installation. This system requires little technical knowledge for maintenance, takes little space and is being used successfully on effluent waste control at the present time.



Pneumatic Conveyor Cools Hydrated Crystals

Robert W. Moore
Metallurgist, Attleboro Refining Co. Attleboro, Mass.

We produce a fine, hydrated metallic sulfate salt which formerly was bagged directly from the dryer. This gave trouble with caking in the bags as the material cooled due to the high vapor pressure of the hydrated crystals at the dryer exit temperature of 140 F.

Drying is accomplished by feeding the crystals through a vibrating-screen type dryer with air passing vertically upward through the moving bed. The crystals go into the dryer at ambient temperature with about 3% moisture and exit at 140 F. with ½% moisture.

The modification which eliminated this difficulty consisted in interposing a pneumatic conveying system between the dryer and the weighing and bagging equipment. Room air is the conveying medium. To avoid drawing hot air from the dryer into the duct the crystals drop through a constricted chute which produces a choke effect.

This arrangement reduces the product temperature to 90 to 100 F., where vapor pressure is low enough to eliminate caking in the bags. The pneumatic system also eliminated a transfer system from dryer to bagging equipment.

Tips on Maintaining Stainless Steel Ware

Paul C. Ziemke
Engineer, Clinton, Tenn.

"Stainless," as applied to stainless steel ware, can be a bit misleading under some circumstances since discoloration can occur from any of several causes. To keep stainless tanks and kettles in good shape one must be prepared for a little simple maintenance.

Stainless steel should be cleaned as often as deposits, stains from corrosives, or discolorations from excessive heat are noticed. Long delay means a bigger job; it would have required a minimum of effort if it had been handled as a routine matter.

Initially, all that's needed is hot soap suds combined with a little stainless steel polishing powder, applied with a soft rag. For a more persistent stain or deposit, use stainless wool or a stainless steel wire brush. To use carbon steel wool invites trouble since minute fragments embed themselves in cracks and crevices, later leading to deeply ingrained rust stains that are most difficult to eradicate.

It is smart to keep weldments and crevices scrupulously clean since discoloration tends to spread from neglected angles and joints.

Sometimes discoloration can be traced to galvanic action caused by contact with dissimilar metals. Staining may come from prolonged contact with bromides, chlorides, iodides and cyanates, especially if acid. To prevent pitting, these materials can be rendered alkaline, or the contact time reduced, with cleaning between uses of the equipment.

While common salt ordinarily has little effect on stainless, it can cause pitting if allowed to sun-dry, with repeated wetting and drying.

Local overheating from welding or a process mishap can cause serious discoloration. The resulting stain can be taken off by the vigorous application of hot suds and stainless powder, applied with a stainless steel brush.

NEXT ISSUE: Measure Gas Temperature With a Flow Meter

By Donald S. Scott, Winner of the September Contest

★ How Readers Can Win

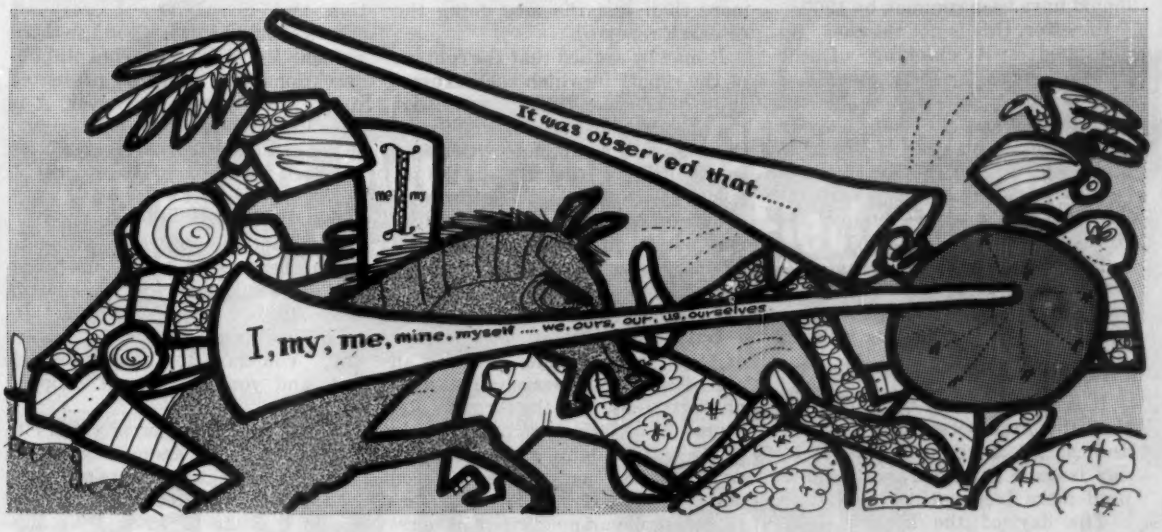
$50 Prize for a Good Idea—Until further notice the Editors of *Chemical Engineering* will award $50 each four weeks to the author of the best short article received during that period and accepted for Plant or Design Notebook.

Each period's winner will be announced in the second following issue and published in the third or fourth following issue.

$100 Annual Prize—At the end of each year the period winners will be rejudged and the year's best awarded an additional $100 prize.

How to Enter Contest—Any reader (except a McGraw-Hill employee) may submit as many contest entries as he wishes. Acceptable material must be previously unpublished and should be short, preferably not over 500 words, but illustrated if possible. Acceptable non-winning articles will be published at space rates ($10 min.)

Articles should interest chemical engineers in development, design or production. They may deal with useful methods, data, calculations. Address Plant & Design Notebooks, *Chemical Engineering*, 330 W. 42nd St., New York 36, N. Y.



Today, Accuracy Demands the First Person

An authority on chemical engineering reports explains why use of first person in technical writing is not a question of style, but rather one of accuracy.

Ethaline Cortelyou, Armour Research Foundation, Chicago, Ill.

Usually a technical education trains a student to work with numbers and ideas, and very little time is devoted to learning to work with words. Although the engineering student is warned against overuse of the first person singular in his high school and freshman college English compositions, he is not forbidden to use it.

In his only other "creative" writing—a few personal letters—he naturally writes in the first person, usually the first person singular, I.

Therefore, it's scarcely surprising that he writes poor engineering reports when the rules are suddenly changed, and he is told that he must write in the third person, so that his reports will be truly scientific, objective and impersonal.

His confusion is not decreased by reminders that reports written in the active voice have greater reader interest. If he tries to apply the two rules literally he may produce, "The authors determined the crush strength of 14 specimens."

But he is just as likely to come up with, "The specimen suffered repeated blows without breaking."

Often he forgets the advice, "Make your sentences march by using active verbs," and writes in the passive voice. However, writing in the passive voice seems to produce naturally such gems as, "Heating with agitation, the sample was dissolved."

Most Editors Agree

I am sure that most editors of technical reports agree that it is easier for research men to write their reports in the first person active voice. After all, when a researcher talks about his work, he naturally says, "We tried" or "I added". Indeed, some specialists have recommended allowing a man to write in the first person and then having the editor convert to the impersonal third person.

But why should anyone—either the author or the editor—have to convert to the third person? Why must technical reports be written in the third person? Because it is customary?

Early British scientists, with whose writings we so often unfavorably compare modern American scientific writing, wrote in the first person—and in the first person singular, at that, because team research was less common then than it is today.

When did we change and why? When I first started this crusade to make report writing easier by permitting use of the first person. I argued that our present style was a hold-over from the 50 years of German domination of chemistry. I assumed that British and American chemists educated in Germany or by teachers who had studied there would adopt the more formal German writing style.

I reasoned that "One finds" and "One sees" would seem a trifle stilted to Americans who would be

inclined to use the passive "It is found" and "It can be seen" which the German *"Man findet"* and *"Man sieht"* avoid. If this were true, the third-person or passive usage should have been common by 1900.

However, this is not the case. By continued spot checking of the *Proceedings of the Royal Society of London* and of the *Journal of the American Chemical Society*, I found that our present style is about 35 years old. In the matter of third-person usage, also, Americans adopted the practice before the British.

Therefore, the argument of custom is a rather specious one for forbidding the use of the first person in scientific or engineering writing.

Using "I" Can Mislead Reader

It is not necessary to remind you that the first person has a plural and that, because most research today is team research, *we* would be used more frequently than I.

The day of the lone wolf researcher is past, so that to report "We found that" or "We tested" would be normal usage and would not be resorting to the *editorial we*.

Certainly the use of the first person should not be prohibited as immodest or boasting, even when *I* must be used. "It was found that," "It is concluded that" or "It was thought that" may seem to imply acceptance of an observation by more than just the men doing the research reported.

It may be argued that the context of the report in which such expressions are used would indicate that the observations were those of only the research team, and, probably, this is usually true. But in the introduction or in other sections of general discussion in a report it may not be obvious whose opinions or observations are being cited.

The Age of Contract Research

Our times are not only an age of team research, they are also an age of contract research. Research organizations, like the Armour Research Foundation are not the only organizations doing research under contract. In many colleges, even one-man chemistry and chemical engineering departments may have research contracts.

The government is the largest sponsor of contract research, and on large government contracts, a contractor may subcontract some of the research. Indeed, on some contracts there are subcontractors to subcontracts. Whatever its size, each contract and subcontract requires at least one report in which the sponsor expects conclusions and recommendations.

Many research contracts do not involve any end items other than reports, so that, in effect, the sponsors are paying the research organizations for conclusions and recommendations. Therefore, it is my opinion that in stating conclusions and recommendations the first person should be used; and the responsibilities of the research team should be acknowledged in the report by such usage as "We concluded that," "We found that," "In our opinion" and "We recommend that."

I consider it mandatory to use the first person and active voice in stating conclusions and recommendations for a sponsor even though the rest of a report may be written in the third person and in passive voice.

I hope that I am not considered inconsistent when I say that I would not like to see a return to the use of the first person in describing step-by-step all the procedures followed. I prefer to use the third person in describing procedures and reserve the first person for statements of opinion, conclusions, recommendations and unique observations.

Certainly background information and discussion of work of others should be written in the third person. Verifiable experimental observations also could be presented in the third person; however, it is more effective to use the first person in describing such observations as have not yet been verified by others.

Makes Hedging Difficult

One of the biggest, although often unexpressed, objections to the use of the first person probably is that its use makes hedging extremely difficult. As you engineers say, "You have to stick your neck out, and you may get it chopped off."

Although an author might try to hide behind the anonymity of "It would seem that the probable cause of the discrepancies might be," he would hesitate to write, "We suppose the discrepancies might be caused by." To some authors it seems less damning to write, "The causes of these phenomena are not known," rather than to write, "We don't know what causes the phenomena."

An author may write, "It is believed that" (unfortunately, he is more likely to write, "It is felt that") in the ostrich-like hope that if he later finds he was wrong the sponsor will assume that he is correcting a previously held misconception. Therefore, I favor the use of the first person because it would force an author to acknowledge his own conclusions and his own shortcomings.

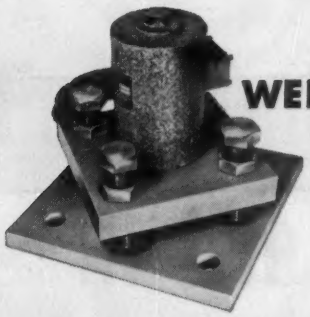
Writing in the first person active voice would meet these rules for writing more interesting technical reports:

- Use personal words.
- Make subjects act.
- Write short sentences.
- Be specific.

Much as I love an argument, I must confess to failing time and time again to get one when I have challenged even the most conservative research administrators with this idea and immediately reminded them that the first person has a plural that would be properly used in reporting the results of team research.

MRS. CORTELYOU *is literary analyst on the director's staff at Armour Research Foundation of Illinois Institute of Technology where she serves in an advisory capacity on all phases of technical documentation. Originally a research chemist and a college chemistry instructor, she has specialized in chemistry and chemical engineering reports. Her industry experience was gained with Container Corp. of America, Indiana Steel Products, Kingsbury Ordnance Plant and the Manhattan Project (Univ. of Chicago).*

Condensed from paper presented at 1958 San Francisco Meeting of ACS.



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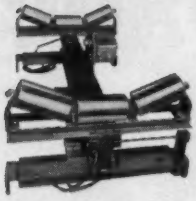
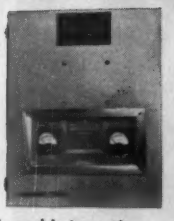
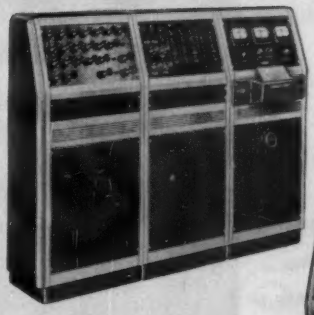


Belt conveyor scale and instrument

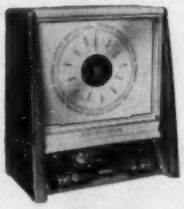


Read-out to auto-typewriter or tape

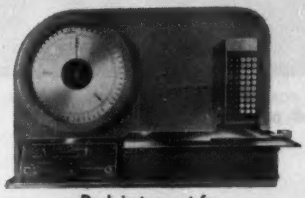


Punch card operated sequence batcher

Sequence batcher for manual programming



Desk instrument for weighing



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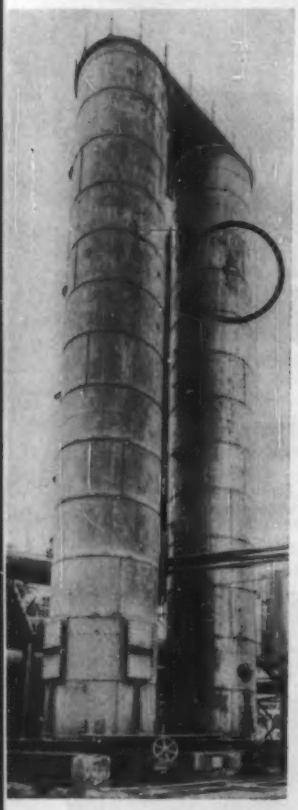


Proved versatility for . . .

. . . BIG JOBS, such as this corroded 40-ft.-high gas cooler repaired in place with novel plastic metals.

. . . SMALL JOBS: worn centrifugals put back on the line after repair with metal-based plastic putty.

Plastic Metals Minimize Plant Shutdowns

Becoming popular in chemical plants, plastic and putty-like metals—used for repairing corroded process equipment—are greatly reducing costly downtime.

Until recently there wasn't much you could do with corroded, leaky process equipment except shut down, pull the unit out and repair it by the usual methods, or replace it.

Now there are a number of techniques available for repair of large and small chemical equipment, requiring a minimum of downtime. In some cases repairs are carried out without any process interruption.

For pipelines, there are the epoxy-impregnated glass-fiber repair kits (*Chem. Eng.*, Jan. 27, 1958, p. 148).

▶ **Plastic Metals Gaining**—And also gaining attention in the chemical industry are the metal plastic materials.

These putty compounds, which harden after they are applied, are not entirely new. But their use has been limited to very small-scale equipment. A number of adventurous chemical companies are currently repairing large vessels, towers, pumps, compressors with metal putty.

The technique is a simple one. Equipment, particularly badly corroded equipment, can be repaired in place. However, the area where you're applying the putty must be thoroughly clean and dry. Heat is not necessary, so process solvent fumes don't present a hazard during repairing operations.

Some of these repairs are permanent, others temporary until the equipment can be conveniently shut down.

▶ **Composition Important** — The plastic-metal putty contains about 80% powdered metal, 20% plastic.* A curing agent is added to the putty just before application. Then the putty is put on a

* A liquid material is also available.

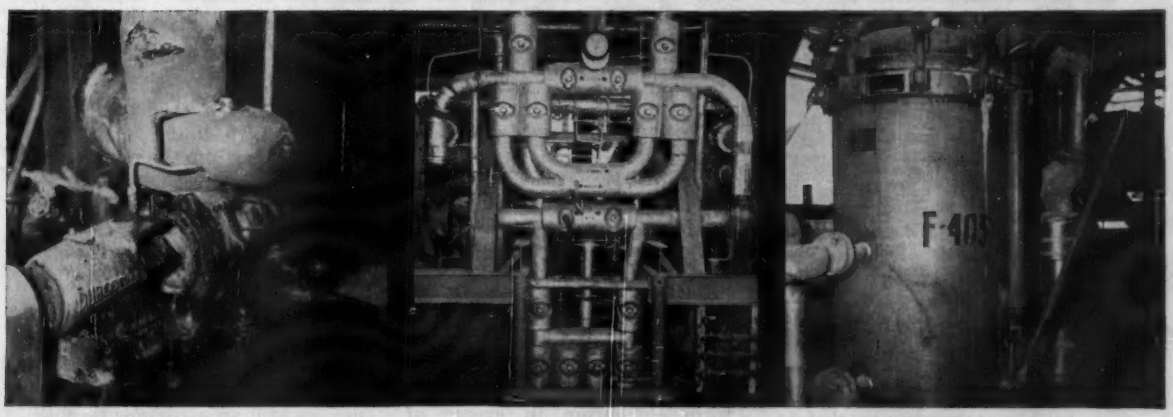
For handling tough corrosives in the production of urea

The Grand River Chemical Division of

DEERE & Company uses DURCO pumps, valves, filters

Durco process equipment has been *the* answer to many of the severe corrosives handling problems at Deere & Company's Grand River Chemical Division. Durco Type F Valves, Series R Durcopumps, and Durco-Enzinger filtration equipment have smoothed the flow of urea by reducing down-time and lowering maintenance costs.

For more than a hundred years, John Deere has been serving America by supplying farmers with the finest of materials and equipment. For nearly fifty years, the Duriron Company has been building and supplying the very best of chemical service equipment.

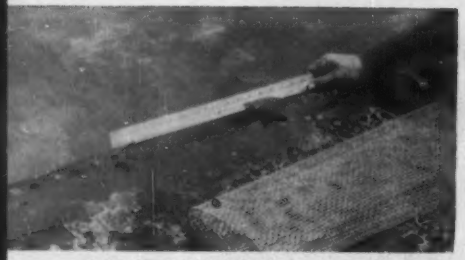


DURCO CORROSION RESISTING ALLOYS & EQUIPMENT

the mark of dependability in tough chemical service...everywhere

THE DURIRON COMPANY, INC., DAYTON, OHIO

Branch Offices: Baltimore, Boston, Buffalo, Chicago, Cleveland, Detroit, Houston, Knoxville, Los Angeles, New York, Pensacola, Philadelphia, and Pittsburgh



LARGE CORRODED areas: cover with wire mesh before applying metal putty.

corroded surface with a knife or spatula. The patch cures and hardens in a few hours at room temperature and any excess can be removed by filing or grinding.

There are two companies active in the production and application of plastic putties to chemical equipment. Smooth-On Manufacturing, Jersey City, N. J., makes an aluminum-powder-based putty using an epoxy resin. Devcon Corp., Danvers, Mass., makes a line of putties (powdered iron, steel, aluminum). The plastic used is related to oxirane resins. Cost of the putties: around $2 to $3/lb.†

▶ **New Lead Putty**—Devcon has just introduced a new putty containing lead (94% lead, 6% plastic). They claim two hours after addition of a special hardening agent, the mixture becomes tough and ductile, very similar to lead itself. It looks promising for the repair of lead and lead-lined tanks. The putty should be less expensive, less dangerous and less time consuming than the usual lead-burning techniques.

Also coming along are plastic brass and bronze compositions, now in the research stage.

▶ **Corrosion Resistance**—As for corrosion resistance, laboratory and field tests show that the metal putties, particularly steel and aluminum, have excellent resistance to most solvents, stand up fairly well to hydrochloric acid (100 and 50%) and 50% sulfuric, but fail against 100% sulfuric.

Besides chemical equipment repair, metal putties have found a steadily increasing market in the metal working industry for repair of tools, jigs, dies, molds. In fact, they were originally developed for this type of work. Holes in castings are filled, broken molds repaired.

Now the putties are used for repair of leaky 15,000 to 80,000 barrel storage tanks, for building up worn centrifugal cast-iron pumps, for repairing corroded gas-coolers and high-pressure pipelines.

Devcon cites the case where a steel-containing putty was used to repair a ⅛-in. hole in a chemical pipe line. The patch withstood an internal pressure of 15,000 psi. and repeated heating and cooling.

Gulf Oil is reported using metal putty on riveted and welded storage tanks which were leaking along the side and bottom. Some of the holes, resulting from corrosion, were ¾ to 8-in. long.

First the tanks were thoroughly wirebrushed and cleaned. Metal putty was applied to the small holes. Wire mesh was applied to the large holes and putty trowelled into place over the wire. By this technique, Gulf avoided a costly job of replacing tank bottoms and roofs.

† Narmco Resins and Coatings, Costa Mesa, Calif., makes a special putty which remains soft and putty-like after application. It is recommended for abrasive service.

New Ti-Alloys Stronger, More Resistant

Things are looking up for titanium. Another major producer —Mallory-Sharon—has developed four radically new, high-strength titanium alloys.

Crucible Steel previously announced their new, easy-to-work titanium alloys (*Chem. Eng.*, Aug. 11, 1958, p. 162).

First of the new alloys, on which work began in 1955, is designated MST-2½ Al-16V. This is composed of 2½% aluminum and 16% vanadium. It can be easily worked in a low strength condition, and then age hardened or strengthened to high tensile strength.

In its solution-treated form, the alloy ranges below 65,000 psi. in yield strength, has uniform elongation in excess of 10%, permitting easy forming of sheet metal components. A simple aging treatment increases the ultimate tensile strength to 155,000-200,000 psi. Aging treatments have been developed which will produce any strength level within this range.

Mallory-Sharon metallurgists believe titanium MST-2½ Al-16V will be competitive as a honeycomb structural material for use in aircraft.

Two other highly significant factors contribute to this alloy's use in honeycomb structures: its heat treatment cycle coincides with the brazing cycle for honeycomb structures, and the material has better ductility and is suited to continuous rolling processes used to produce the foil necessary to make honeycomb. Available now in sheet, strip, bar, billet and wire, the new alloy exhibits a high tolerance for hydrogen—at least 500 ppm. This is four times the existing hydrogen tolerance of present commercial alloys.

Also, the alloy has shown better corrosion resistance than pure titanium in certain media. This is considered extremely important by Mallory-Sharon engineers developing high-pressure tubing for use in acid or corrosive media.

A second alloy in the new group is MST 821, composed of 8% aluminum, 2% columbium (niobium) and 1% tantalum. Covered by a specific as well as general alloy patent, it was developed as a material which would be arc-weldable, yet still retaining high ultimate tensile strength and good ductility. It has excellent high temperature strength, expanding the useful temperature range of titanium alloys in this field by at least 150 F.

It's predicted that this alloy will allow titanium to expand much further into the missile industry, where weldability is a must. Its use as a forging material will also broaden uses in the new generation of jet engines, allowing additional use of titanium alloys farther back in jet engines for rotors and blades.

Another of the new alloys is MST 185, which Mallory-Sharon metallurgists describe, at present, as still an experimental material. Its formulation is based on an alloy having high strength in the annealed condition. As such, it requires no additional heat treatment, and thus avoids the dimensional changes which occur in parts which must be heat-treated after forming.

SOLVENT PACKINGS

"We tested one packing after another... but only 'U.S.' could stand up,"

Says CHEMICAL PLANT SUPERINTENDENT

When a leading mid-western chemical company put their new plant into operation in 1955, they faced a problem with pump packings: To find a packing resistant to a combination of solvents, caustic and high temperature—with a minimum of shaft wear.

"We tested one packing after another on our caustic pumps," says the plant superintendent, "and found that U. S. Solvent Packing outlasted any other packing tested *by as much as 10 to 1.*"

Result: No more morale-breaking "clean-up" sessions, production is increased, personal injuries due to leaks have been reduced 75%, and there's no need for rescheduling due to breakdowns.

A "U. S." technician, of course, worked with engineers of the chemical company to develop the right packing for this particular requirement. That's part of the "U. S." service, when needed.

• • •

When you think of rubber, think of your "U. S." Distributor. He's your best on-the-spot source of technical aid, quick delivery and quality industrial rubber products.

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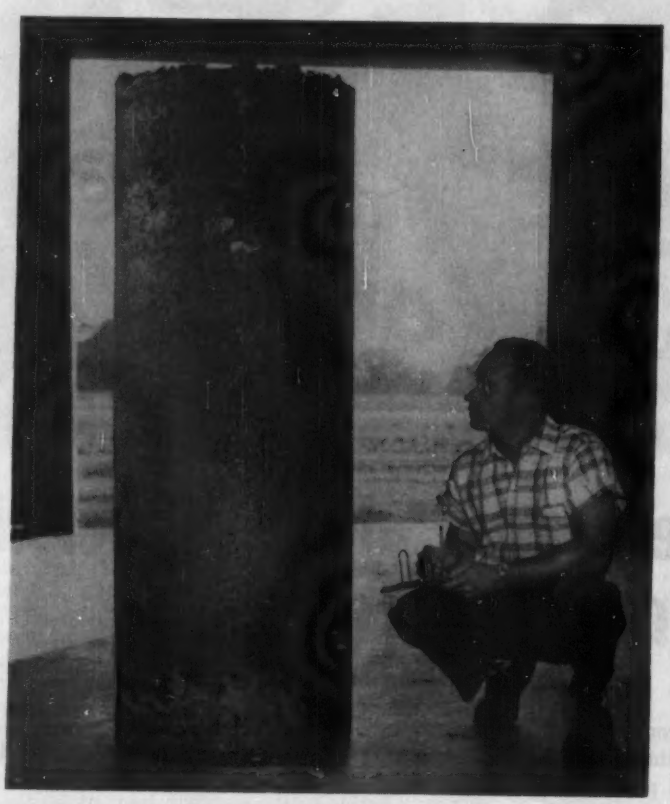
This same material, when age-hardened, has shown a high ultimate tensile strength, ranging as high as 260,000 psi., compared with steel at over 400,000 psi. MST 185 has a heat treatment cycle compatible with honeycomb brazing cycles.

Completing the string of new Mallory-Sharon titanium alloys is MST-3Al-2½V, composed of 3% aluminum and 2½% vanadium. This material is the first titanium alloy specifically designed for high strength tubing. It is highly weldable and formable, and stands alone among titanium alloys in its resistance to corrosion.

Tubing made from this alloy can be flared 50% or more—equivalent strength commercially pure titanium tubing can be flared only 15%. By suitable age-hardening treatment, MST-3Al-2½V tubing can be strengthened after fabrication to an ultimate strength of 120,000 to 130,000 psi.

With the exception of MST 185, all these alloys are now available in standard mill shapes and forms.



Giant Zr Ingots to Yield Low-Cost Mill Products

The largest zirconium ingot ever formed—6,700 lb.—has been melted by Mallory-Sharon at Niles, Ohio.

Made from zirconium sponge (sodium reduction process), the huge ingot will have a big effect on cost of sheet and strip zirconium.

Mallory-Sharon engineers predict use of giant ingots may make possible 10-15% savings in strip costs at the mill.

The ingot above is suitable for a continuous blooming mill, while the usual 1,000 to 2,000 lb. ingots are used primarily in forging.

Brighter Atomic Future For Aluminum Alloys?

The future of aluminum as a material in pressurized-water reactors looks very much brighter than it did several years ago, according to a recent report by W. E. Berry and F. W. Fink of Battelle Memorial Institute for the AEC (Nuclear Technology Briefs No. T1-8).

Commercially pure aluminum (1100) sheet costs 45¢/lb., about 1/60 that of Zircaloy-2. For this reason much attention has been focused on aluminum as a reactor cladding material, say the authors. But while it has low thermal neutron cross-section, is corrosion resistant and easily fabricated, it has two major drawbacks: low strength at power reactor temperatures and poor corrosion resistance in high-purity, high-temperature water.

Much of the atomic work going on now centers around improving aluminum's corrosion resistance.

A number of atomic laboratories are investigating newly developed aluminum alloys, including Argonne, Knolls Atomic Power, Hanford, Bettis Atom Power and Canada's Chalk River installation. Extensively evaluated are M-388 and M-400 alloys containing nickel, iron and silicon. And X-2219, containing iron, silicon, copper, manganese, vanadium and zirconium.

To date corrosion resistance is not as good as Zircaloy-2. At 550 F., M-388 corrodes at the rate of 1.0 mil/yr., X 2219 at 1.7 mil/yr. Corresponding rate for Zircaloy-2 is 0.03 mil/yr. At 600 F. corrosion is 3 to 6 mil/yr. for M-388, X-2219 has a 4.2 mil/yr. rate, while Zircaloy-2 has a low rate of 0.04.

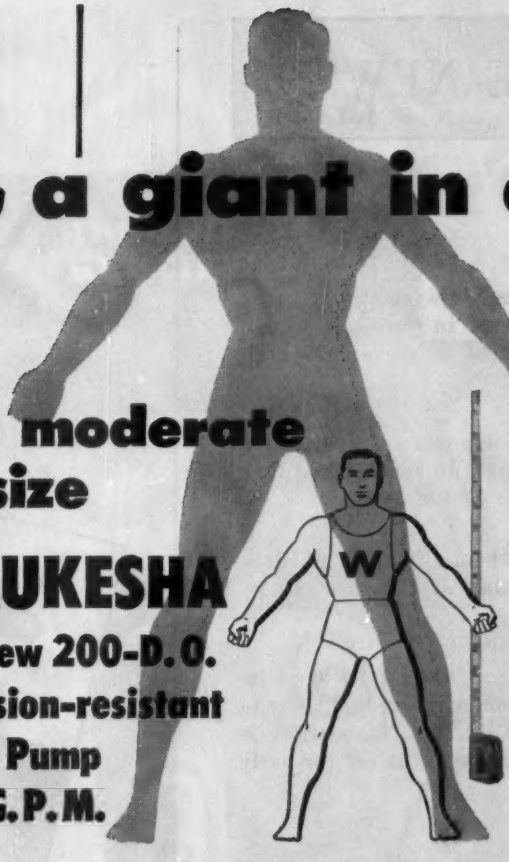
Nevertheless the work is encouraging, since the new aluminum alloys are a big improvement over unalloyed aluminum metal.

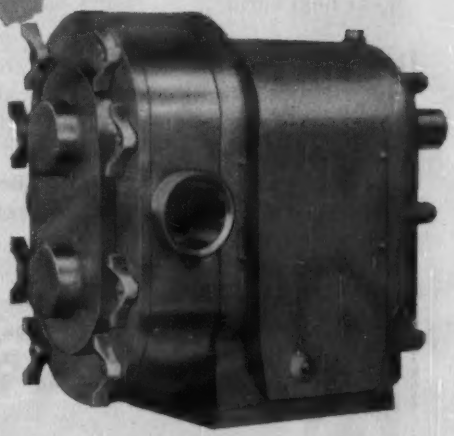
Now, a giant in capacity...

yet moderate in size

WAUKESHA

The New 200-D.O. Corrosion-resistant P.D.* Pump 300 G.P.M.





*Positive Displacement

Ever-growing production demands by industries requiring corrosion-resistant positive displacement pumps, led WAUKESHA Engineers to develop this enormously thirsty addition to the WAUKESHA family.

If there are higher capacity pumps of this type, we've never heard of them.

The 300 G.P.M capacity is the maximum. 285 G.P.M. is against 100 p.s.i. 200 G.P.M. is against 150 p.s.i. Against pressures of 100 p.s.i., this youthful giant will faithfully deliver any of these capacities.

And despite this extraordinary pumping production, the new WAUKESHA is only 17 inches high . . . plenty of clearance with minimum floor space required. Super-capacity is gained by large inlet and outlet ports (4 inches in diameter) — a larger impellor, yet a surprisingly small increase in over-all dimensions.

- With the new WAUKESHA 200 D.O. Pump you readily meet today's production requirements with capacity-provision for your future expansion.
- For pumping lines that may need protection against sudden high back pressures, or with accurate delivered capacity into filler bowls the new WAUKESHA 200 D.O. can be furnished with a vented cover.
- In fact, all the user-benefits, all the engineering efficiencies, all the new sealing improvements provided by the WAUKESHA PUMP family are yours in the new WAUKESHA 200 D.O.

ONLY Waukesha gives you a quarter century's experience and reliability

Send for the Bulletin describing the new WAUKESHA No. 200 D.O. corrosion-resistant Pump. Just a postcard will do.

Waukesha FOUNDRY COMPANY

Dept. U-11, WAUKESHA, WISCONSIN

FIRMS IN THE NEWS

R. A. LABINE

NEW FACILITIES

November's Top Projects:

Celgar Development Co. has process study under way for its $30-million pulp mill near Castlegar in Canada's Arrow Lakes region. Construction is expected to move into high gear next spring.

Dow Badische Chemical Co. is starting site preparation for its acetylene chemicals plant located next to Dow's Plant B in Freeport, Tex. Target onstream date: End of 1959.

Stauffer plans to have a "multimillion-pound facility" at Richmond, Calif., in production by next January to turn out its new selective herbicide, Eptam

Air Reduction Co. and Mastic Tile Corp. of America are joining forces to produce vinyl chloride monomer and polymer in a new $10-million plant at Calvert City, Ky. Blaw-Knox is handling design and construction; completion is set for early 1960.

Dow Chemical has added a $500,000 semicommercial plant at Midland, Mich., to provide a ready source of specialty organic chemicals and to cut down the time lag between the laboratory and full-scale production. Facility is a versatile collection of process equipment that can be converted to handle a wide range of products and processes.

American Cyanamid is ready to start commercial production of its Creslan acrylic fiber at a $25-million plant near Pensacola, Fla. Plant is rated at 27 million lb./yr.

Stauffer has doubled production capacity at Henderson, Nev., for its insecticide-miticide, Trithion. Firm's first Trithion plant came on stream at Henderson just last April.

Callery Chemical Co. officially dedicated its $38-million high-energy fuel plant at Muskogee, Okla., on Nov. 1. Plant turns out boron-based HiCal fuel for the Navy.

Standard Oil of California has awarded contract to Fluor Corp. for alkylation and isomerization units for Stancal's Richmond, Calif., refinery. Units, together with 55,000-bbl./day catalytic cracker already under construction by Fluor, are slated to swing on stream next spring.

Linde is giving midwestern oxygen capacity another boost with a 130-ton/day oxygen plant firm is building for the Middletown, Ohio, Works of Armco Steel Corp.

Petroleum Chemical's 200-million-lb./yr. ethylene plant at Lake Charles, La., has gone on stream; plant also produces propylene. Unit is linked by 30-mi. pipeline to Du Pont and Spencer Chemical plants at Orange, Tex., with about half of plant's output ticketed for the pipeline. At the same time, the $11-million ethylene glycol plant at Lake Charles that P.C.I. designed and will operate for Calcasieu Chemical went on stream. Annual capacity: 8 million gal.

British American Oil's $25-million gas processing and sulfur plant at Pincher Creek, Alta., has be-

ALLIS-CHALMERS

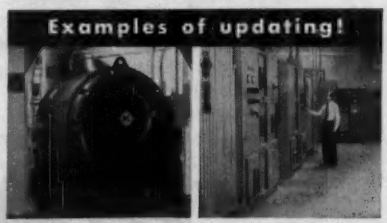
ALLIS-CHALMERS

NEW brochure of ideas for modernizing

This booklet is based on the premise that modernization can start anywhere in your plant. It can be a single machine or operation . . . a better way of getting variable speed . . . a faster way to braze . . . or a newly available replacement. In fact, this type of updating is far more common than the sweeping change.

Get a copy of "59 ideas for modernization in '59" from your nearby A-C office or write Allis-Chalmers, Industries Group, Milwaukee 1, Wisconsin.

Examples of updating!



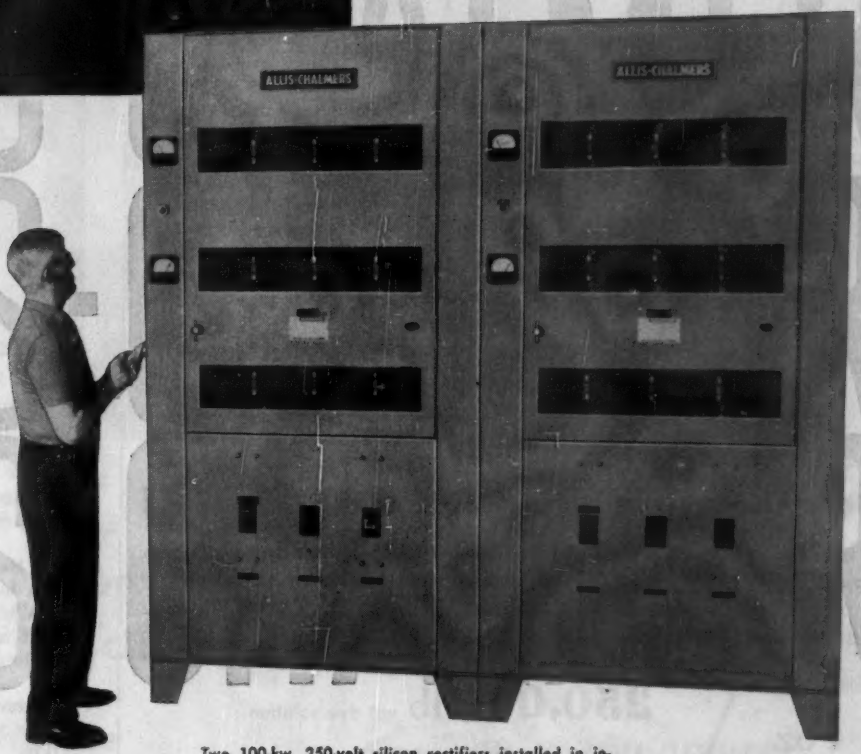
New motor development may eliminate premiums you've been paying for specially protected motors.

Electrical modernization includes placing substations close to machines being served.

ALLIS-CHALMERS

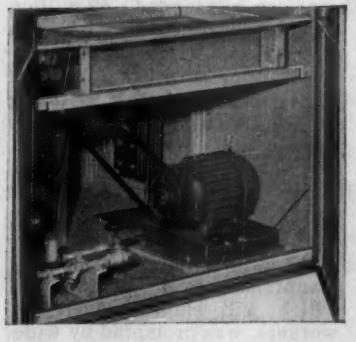
A-5850

SEMI-CONDUCTOR RECTIFIER



Two 100-kw, 250-volt silicon rectifiers installed in industrial service. Semi-conductor rectifiers are simple in operation and maintenance, require little floor space.

Plan to stay ahead... MODERNIZE!



Effective cooling — closed recirculating air system features air-to-water heat exchange and delivers same amount of cooling air to each diode. Air is sealed in. Direct air cooling system also available.

Only application experience like this can give you highest conversion efficiency

High power conversion efficiency at low cost is the major advantage of the semi-conductor rectifier. But this high efficiency — as high as 95% — can be obtained only when the unit is *correctly applied.*

Allis-Chalmers 30 years of experience in developing, manufacturing and *applying* rectifiers assures you of the highest conversion efficiency. This background of experience, plus vast research and engineering facilities, is available for a thorough analysis of your requirements. Then, specific, unbiased equipment recommendations are made — dictated solely by your requirements — because Allis-Chalmers makes all types of rectifiers.

Every semi-conductor rectifier installed by Allis-Chalmers has performed to the complete satisfaction of the user. Your local A-C man can tell you how a semi-conductor rectifier can be applied profitably to your operations. Call him. Or write Allis-Chalmers, Industrial Equipment Division, Milwaukee 1, Wisconsin.

A-C ALLIS-CHALMERS

ALLIS-CHALMERS

A-5817

oust it with a Dow Corning SILICONE DEFOAMER!

When foam moves *in*, efficiency moves *out* . . . production goes down! Costs go up! If foam is hogging space in your plant, knock it down with Dow Corning SILICONE DEFOAMERS . . . most versatile and effective foam killers made!

1 oz kills foam in:

250,000 lb vat dye solution

125,000 lb asphalt

62,500 lb hypo fix and film developer

FREE SAMPLE! Make your own test. Return coupon below for generous *trial sample* of a Dow Corning SILICONE DEFOAMER. No obligation, of course.

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NAME

TITLE

COMPANY

CITY ZONE STATE

My foamer is

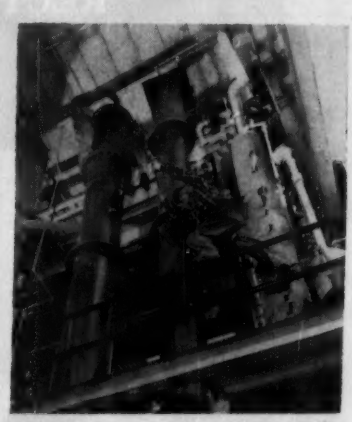
Oil system

Aqueous system

Food products

Other

gun delivering processed gas to the Alberta Gas trunk line for line fill and test purposes. This is the first in a series of steps that will link the Pincher Creek field with eastern markets.



General Electric has started up a new semiworks plant at Pittsfield, Mass., to produce development quantities of its polycarbonate resin, Lexan. Plant is also designed to furnish data for commercial plant design.

Derby Refining will install a 1,700-bbl./day HF alkylation unit at its Wichita., Kan., refinery. Contract with Procon calls for completion by May 1959.

Continental Carbon announces plans to expand its Ponca City, Okla., carbon plant by 50%. Completion is scheduled for fall, 1959; annual capacity will be 75 million lb. of all grades of furnace black.

Fluor Corp. has landed a $2-million contract from Pacific Supply Cooperative to engineer and construct product tankage, piping, utilities and office-shop building for Pacific's new 15,000-bbl./day refinery at Vancouver, Wash.

Du Pont's newly formed Belgian subsidiary, Du Pont de Nemours (Belgium) S.A., is building a plant 12 mi. north of Brussels to manufacture paints. Plant, which will employ about 100 workers, was prompted by wider trade opportunities under European common market treaty.

Sherwin-Williams plans to add 12,000 sq. ft. manufacturing space

ALLIS-CHALMERS

Here's **double assurance** of complete satisfaction in **dielectric heating**

1. The heater

The expertly crafted enclosure tells you — here's quality. Operating convenience is immediately apparent in the eye-level grouping of controls. Protective interlocks are representative of many safety features. And behind the easy-access doors you'll find engineering, workmanship and components that mean standout performance and dependability. For example, the water-cooled oscillator is built for 5000 hours of service. The heavy-duty plate transformer has a large reserve capacity. Clean wiring arrangements, bakelite standoff, ceramic coils, sturdy relays are just a few more reasons why the Allis-Chalmers dielectric heater is preferred equipment.

2. The manufacturer

When you specifiy Allis-Chalmers, skilled electronic engineers help plan the most efficient use of your dielectric heating. The modern A-C laboratory is at your disposal for material testing. Services include the design of work-handling equipment. Installation is supervised by a trained field engineer. Periodic checkup and emergency maintenance service are also supplied by Allis-Chalmers regional offices conveniently located near you.

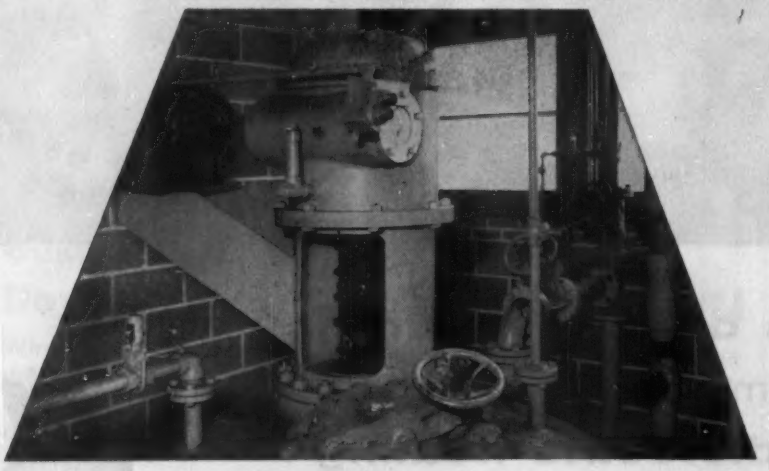
See your Allis-Chalmers representative for complete details or write Allis-Chalmers, Industrial Equipment Division, Milwaukee 1, Wisconsin. Ask for Bulletin 15B6431C.

ALLIS-CHALMERS

A-5774

GET TOP PRODUCTIVITY FROM MINIMUM POWER CONSUMPTION

. . . with NETTCO Engineered Agitation!



ELIMINATE UNSATISFACTORY AGITATION, high power costs, and excessive maintenance with Nettco "process-rated" agitators. Standardized components (motor, drive, shaft, stirrer) can be combined to meet your exact size, speed, HP, and other process specifications. Check these Model T features . . .

- Minimum moving parts in compact, fully enclosed housing
- Interchangeable ratios from 6.25:1 to 100:1
- Dust, fume, and moisture-proof
- Complete range of speeds
- Anti-friction bearings throughout, quiet operation
- Splash lubrication — oil trapped against leakage
- Large diameter "stepped" vertical shaft
- Widely spaced, oversized Timken bearings

Model WT units (worm gear reduction drives) offer ratios from 3.5:1 to 68:1 and can also be "processed-rated" to your specifications for greater savings and dependable, uninterrupted service. Ask Nettco agitation engineers for recommendations. Request Bulletin 551 and data sheet from **New England Tank & Tower Company, 87 Tileston Street, Everett 49, Mass.**

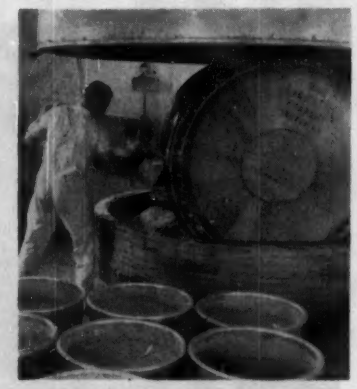
NETTCO
ENGINEERED AGITATION

FREE LITERATURE

Please send me the following literature:

- ☐ Tank Top Agitators—Bulletin 551
- ☐ Portable & Tripod Mixers—Spec. Sheets
- ☐ Pipeline-Flomix®—Bulletin 531
- ☐ Side Entering—Bulletin 532

to firm's Cleveland, Ohio, paint plant. Total project cost will run around $120,000.



American Cyanamid is now in continuous production of ammonium nitrate at a new plant in New Castle, Pa., marking completion of firm's industrial explosives rebuilding and expansion program. Above, New Castle operator blends nitroglycerin, nitrocotton and dope in wooden mixer to make dynamite.

Allis-Chalmers has completed a new combination engineering and research and development building near company's West Allis, Wis., Works. When in full operation, the new Greendale laboratories will house around 200 employees.

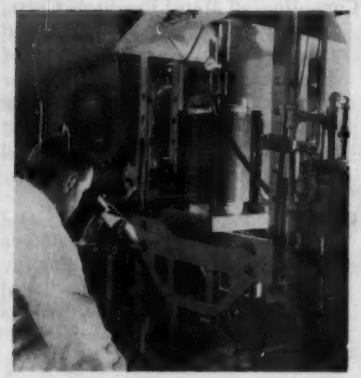
American Cyanamid's Dutch subsidiary, Cyanamid-Ketjen, N.V. (jointly owned with Ketjen, Amsterdam), has started production of platinum Ultraforming catalysts in a new plant in Amsterdam under license from Standard Oil of Indiana.

Lummus Co. of Canada was major contractor on a new 5,400-bbl./day catalytic reforming unit now on stream at British American Oil Co.'s Moose Jaw, Sask., refinery.

Standard Steel Corp., Los Angeles, has opened new $500,000 manufacturing and engineering facilities for alloy fabrication. Firm's new Cryogenics Div. will fabricate low-temperature rocket-fuel tanks for missile industry.

Pulp & Paper Research Institute of Canada's new $2.3-million re-

search laboratories near Montreal are now in operation. The Institute is supported jointly by Canadian Government, the pulp and paper industry, and McGill Univ.



Westinghouse has placed a completely integrated high-temperature induction melting, sintering and pressing facility in operation at East Pittsburgh, Pa., to implement firm's ceramic research and development program.

Vick Chemical's cosmetic interests (including Prince Matchabelli, Inc.) has been sold to Chesebrough-Pond's for an undisclosed amount of cash.

Johns-Manville Corp. has proposed a merger with L.O.F. Glass Fibers Co.; an L.O.F. stockholders' meeting is being called to ratify the plan.

Flintkote Co. is negotiating for acquisition of Orangeburg Mfg. Co., Orangeburg, N. Y. Orangeburg manufactures bituminized fiber sewer and drain pipe and electrical conduits for underground installations.

National Cylinder Gas International, subsidiary of Chemetron Corp., has acquired a substantial interest in five industrial gas firms in Mexico. Construction of

GREENS

4 Pure Chromium Oxides
and
2 Hydrated Chromium Oxides

Most stable of the green pigments. Unaffected by acids, alkalis, vehicles, and solvents. Non-fading.

The 4 pure chromium oxides will withstand ceramic temperatures. Use them in applications requiring permanency—enamels, emulsion paints, rubber, plastics, floor coverings, roofing granules, building materials, etc.

Use the 2 hydrated chromium oxides for obtaining brilliant color and transparency in automotive finishes, high grade enamels and lacquers.

Your nearest Williams representative will be glad to provide you with full technical data and samples, or write Dept. 62, C. K. Williams & Co., Easton, Penna.

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COLORS & PIGMENTS

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EMERYVILLE, CAL.

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FOR ALL YOUR NEEDS

- ☑ CONDENSERS
- ☑ PIPE COILS
- ☑ SHELL-ICE MAKERS
- ☑ VALVES & FITTINGS
- ☑ ICE RESERVE UNITS
- ☑ AIR HANDLING UNITS
- ☑ SHELL & TUBE COOLERS
- ☑ "ECLIPSE" COMPRESSORS
- ☑ HEAVY-DUTY COMPRESSORS
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- ☑ "INSTANT" WATER COOLERS
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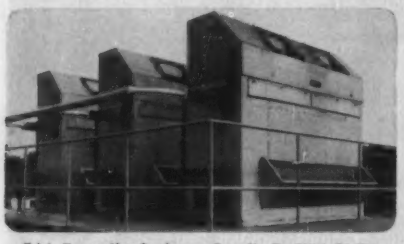
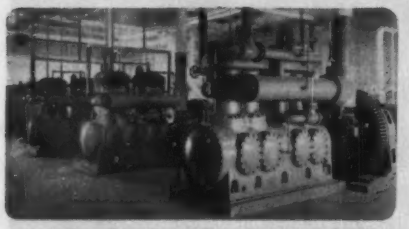


Frick Evaporative Condensers Save Up To 95% Of The Water Used.



Frick Heavy-Duty Four Cylinder Compressors Can Be Adapted to Handle Any Type of Refrigerant.

Frick Shell-Ice—Clear Solid Pieces of Curved Ice. Made Automatically, Without Snow or Waste.

It is a proven fact that today's semi- and full-automatic equipment soon saves enough to pay for itself.

Whatever the refrigeration requirements of your plant—quick freezing, ice making, cold storage, humidity control, low temperatures, condensing, air conditioning, or any process cooling . . . Frick engineers will help you modernize your present system or design one to meet your needs.

Frick refrigeration equipment is world renowned for a long trouble-free life of dependable operation. Many Frick compressors have been in operation for over 40 years.

CALL your nearest Frick Branch or Distributor today. Or write direct to . . . . .

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FRICK CO.

WAYNESBORO, PENNA., U. S. A.

FIRMS . . .

Mexico's first liquid argon plant has already been started by one of the five, Argon de Monterrey. Other companies: Cia. Procuctora de Oxigeno, Electrodos Monterrey, Oxigeno de Chihuahua, and Gases y Electrodos.

Consolidated Metal Products Corp., Albany, N. Y., has purchased the Waldale Research Co. of Pasadena, Calif., manufacturer of electronic strain measuring devices and pressure measuring systems used in missile and rocket field.

Corn Products Refining Co. and The Best Foods, Inc., have merged, forming a new company called Corn Products Co. Total annual sales of the new firm is over $600 million.

NEW COMPANIES

Reichhold Chemicals is establishing, along with several Hong Kong industrialists, a Hong Kong affiliate to manufacture firm's entire line of industrial synthetic resins. Plans are under way for a two-story plant that will be in production by spring of 1959.

Glass Beads Corp., new corporation with headquarters in Latrobe, Pa., has begun production of glass sealing beads used in making electrical assemblies.

NEW LOCATIONS

Chemetron has established a field technical sales and service office for Girdler catalysts in Houston, Tex. Address: 4007 Bellaire Blvd.

Microchemical Specialties Co., manufacturer of quartz and glass ultra-micro apparatus, has moved to 1825 Eastshore Highway, Berkeley, Calif.

CALENDAR

American Institute of Chemical Engineers, North Jersey Section, Topic: Engineering Education, General Chemical Division, Allied Chem. & Dye.
Nov. 4 Morristown, N. J.

Society of Plastics Engineers, Philadelphia Section, Topic: Advances in Injection Molding, Sheraton Hotel.
Nov. 6 Philadelphia, Pa.

National Academy of Sciences, fall meeting, University of California.
Nov. 6-7 Berkeley, Calif.

American Petroleum Institute, 35th annual meeting; Conrad-Hilton, Palmer House, Congress Hotels.
Nov. 10-13 Chicago, Ill.

Chemical Market Research Assn., annual meeting, Sheraton-Ten-Eyck Hotel.
Nov. 12-14 Albany, N. Y.

Society of Plastics Engineers, South California Section, Topic: Plastic Trends in Building Construction, Ambassador Hotel.
Nov. 13 Los Angeles, Calif.

National Assn. of Corrosion Engineers, Western Region Meeting, Hotel Statler.
Nov. 17-19 Los Angeles, Calif.

Society of Plastics Industry, 8th National Plastics Exposition, Morrison Hotel and Chicago Amphitheatre.
Nov. 17-21 Chicago, Ill.

Society of Plastics Industry, 8th National Plastics Exposition, Morrison Hotel and Chicago Amphitheater.
Nov. 17-21 Chicago, Ill.

Department of Health, Education and Welfare, National Conference on Air Pollution, Sheraton Park Hotel.
Nov. 18-20 Washington, D. C.

Commercial Chemical Development Assn.-National Agricultural Chemicals Assn. Lord Baltimore Hotel, Baltimore and Beltsville Research Center.
Nov. 20-21 Beltsville, Md.

Manufacturing Chemists Assn., 8th semiannual meeting, Hotel Statler.
Nov. 25 New York, N. Y.

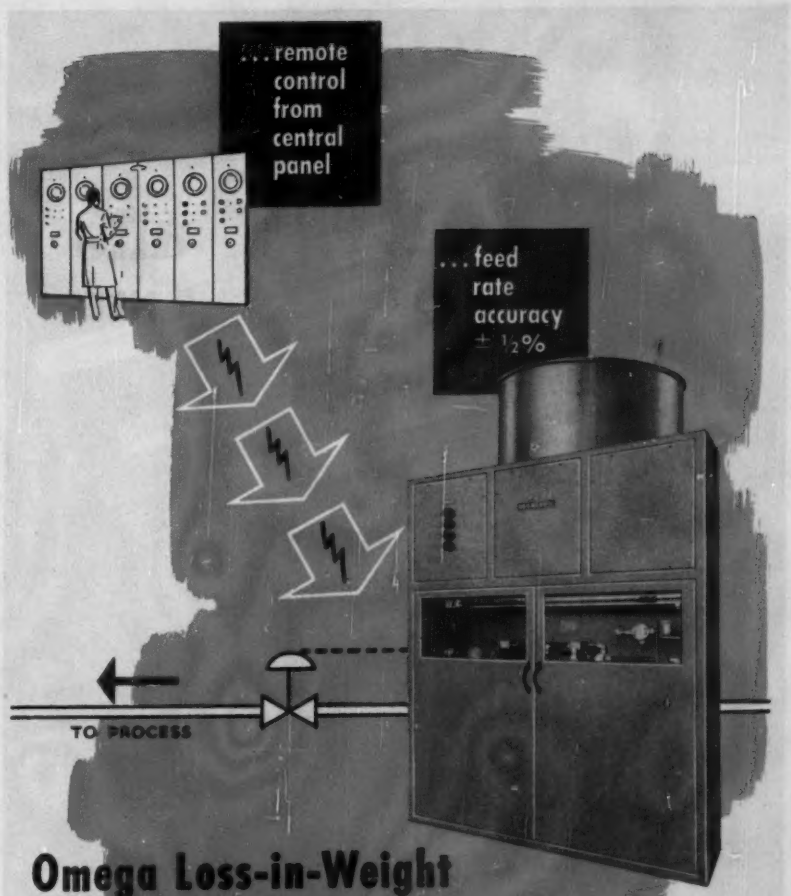
American Society of Mechanical Engineers, 23rd National Power Exposition, New York Coliseum.
Dec. 1-5 New York, N. Y.

Agricultural Ammonia Institute, annual convention, Morrison Hotel.
Dec. 3-5 Chicago, Ill.

Chemical Specialties Manufacturers Assn., 45th annual meeting, Commodore Hotel.
Dec. 9-11 New York, N. Y.

American Nuclear Society, annual meeting, Sheraton-Cadillac Hotel.
Dec. 8-10 Detroit, Mich.

American Assn. for the Advancement of Science, annual meeting, Hotel Statler.
Dec. 29-30 Washington, D. C.



Omega Loss-in-Weight Feeding Systems cut costs, improve quality, and increase production

The new Rohm & Haas plant at Deer Park, Texas, has a critical continuous process which demands *accurate feeding* of all components for its successful operation. After a survey of available continuous feeding equipment, their engineering department selected Omega Loss-in-Weight Feeding Systems to control the feed of the key liquid component into the process. Here's why they made this selection:

Accuracy—The Omega Loss-in-Weight Feeding Systems provide guaranteed accuracy of ±½% by weight of set feed rate.

Remote Control—from central panel complete with printed record

Control-loop—with feedback and memory features.

Explosion-proof—a fully protected system.

The Omega Feeding Systems have amply proven themselves in over a year's operation. Benefits are:

—Better quality control
—Savings in valuable process materials
—Increased production
—Safer working conditions

Write for Bulletin 32-R2 describing Omega Continuous Loss-in-Weight Feeding Systems for liquids and dry materials.

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Everyone tells a story of Savings ...with SOLKA®-FLOC!

This versatile, finely-divided cellulose has so many applications. For example:

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... in the manufacture of Chemical Derivatives of Cellulose

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In this application SOLKA-FLOC gives you greater, more economical volume of clarified filtrate because its finely divided particles trap the tiniest of suspended solids. It makes a stable pre-coat, does not "bleed" and there's no loss of cake due to pressure drop, no abrasion of pulps and valves, minimum retention of filtrate in filter cake.

SOLKA-FLOC effectively adsorbs many metals such as iron, copper and other impurities and can be burned to recover valuable solids. Let us show you how SOLKA-FLOC® will do a better job for you in your product or your process. Address Dept. DF-11 at our Boston office.

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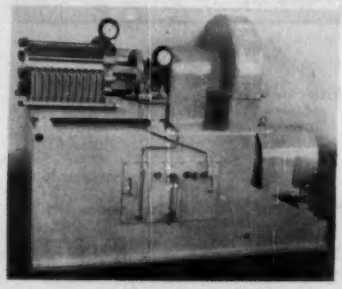
NEW EQUIPMENT . . .

(*Continued from p. 76*)



Continuous Reactor

Combines mixing with controlled heat transfer.

Known as the Flowmaster reactor, a new continuous processing machine combines continuous mixing with accurate process temperature control. Essentially, the reactor consists of a set of beaters mounted on a common shaft that passes through a series of fixed heat transfer plates. The beaters, spaced evenly between the transfer plates, intensively mix all reactants flowing through the plate channels. In addition to mixing, beater action promotes excellent heat transfer rates.

Two standard-size plates are available— 11 and 18 in. across. Fluid circulating through the plates transfers heat to or away from the reactants; or, if desired, the plates also come with electrical heating elements. Standard operating temperatures vary from 32 to 400 F., pressures to 350 psig. Special models boost these limits to 750 F. and 1,000 psi.—**Chemical Machinery Div., Baker Perkins, Inc., Saginaw, Mich.** **164A**

Fork Lift Truck

Power from engine goes to axle via generator.

Employing the Dynamotive drive principle, a new line of fork lift trucks offers low costs of operation and maintenance. Gasoline engines on Dynamotive trucks transmit power through a variable-voltage generator to a matched, d.c., series-wound electric drive motor. Since there is no direct mechanical coupling

between engine and drive axle, transmission of road shock is avoided—maintenance costs are thus kept low. Elimination of clutch, fluid coupling, fluid torque converter and multiple-speed transmission drops big repair parts inventories. And, since this drive arrangement enables the gas engine to operate at its most efficient speed at all times, fuel savings as high as 30% are possible.

Capacities of the Dynamotive truck line range from 4,000 to 10,000 lb., with lifting heights to suit all applications. Fast travel speed is 8½ mph.—**Automatic Transportation Co., Chicago, Ill.** 164B

Cleaning Tool

Swiss-made unit has many process-industry uses.

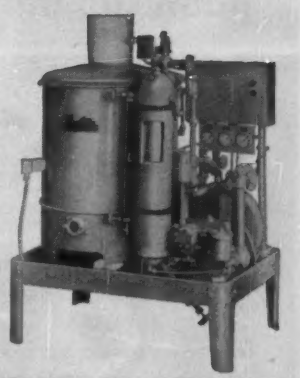
Operating on compressed air, a new light-weight tool de-rusts or de-scales the surface of almost any material. Other typical applications include quick and thorough removal of weld slag from inaccessible spots, cleanup of castings, paint stripping, and roughing-up and cleaning concrete or brick. The tool, known as the Von Arx Pistol raises very little dust. Unlike sandblasting, it doesn't interfere with production of operating units. And protective devices other than safety glasses are unnecessary for personnel working with it—no particles of sand or scale fly about.

In operation, compressed air at 88 psi. drives a bundle of non-connected hardened steel needles against the surface being treated. Since the needles are in no way attached to one another, they operate independently—thus, the end of the

DECENTRALIZED STEAM
with Clayton Steam Generators Costs Less!

When W. P. Fuller was faced with a large boiler repair bill, plus replacement and possible extension of transmission lines, they looked into decentralized steam... using Clayton Steam Generators. Under the proposed Clayton decentralized steam plan, six Claytons replaced the old boiler room... each one located near the *steam job required.* Considerably more usable steam is now produced at less cost! Decentralized steam expensive to install? Not at all! The entire installation expenditure was less than the cost alone of installing new transmission lines! Investigate decentralized steam.

Buying Clayton Steam Generators is just smart business! These steam units produce more steam at less cost in only one-fourth the space occupied by ordinary steam boilers. They cost less to install too... no stacks to erect, no walls to knock out, lower rigging expense and lower hauling costs... and you can put them practically anywhere! The secret of Clayton's higher efficiency is *controlled circulation* and balanced feed, a principle of using a continuous single pass tube... thus, they are more reliable and easier to operate, maintain. From a cold start, Claytons produce steam in 3 minutes... and all day they produce only steam needed—instantaneously. Let a Clayton representative give you the complete facts.



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Compare Clayton's 5-year published coil warranty covering material and labor.

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Name_____

Company_____

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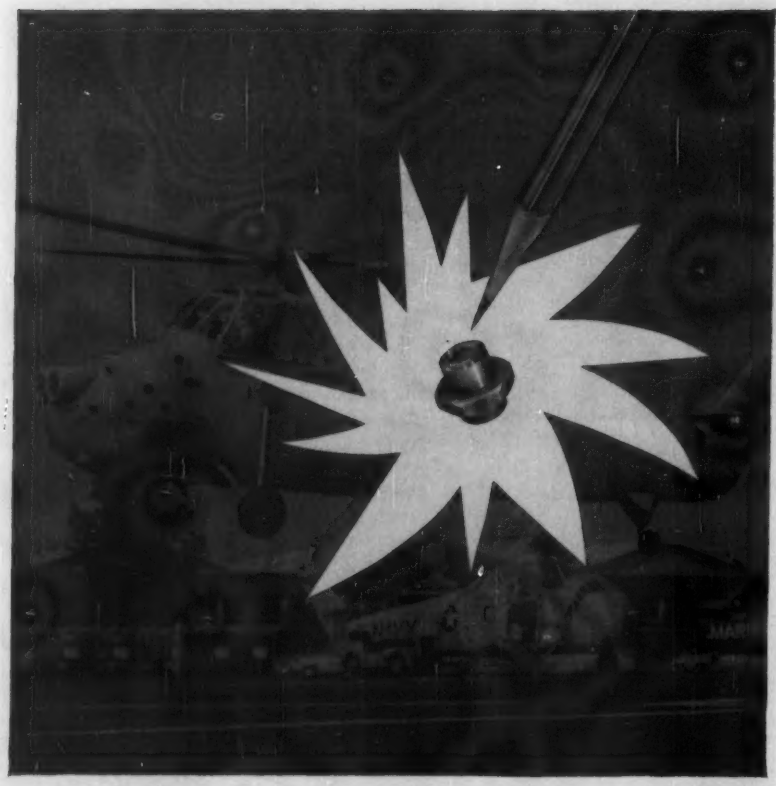
City_____ Zone____ State_____

We use steam for_____

Send to: Clayton Manufacturing Company
409 N. Temple City Blvd.
El Monte, California



16 Spraco Nozzles help the new lightweight G.E. T58 engine pack the punch of a heavyweight!

At the heart of General Electric's new T58 turboshaft engine — a revolutionary new power plant for helicopters that packs over 1,000 horsepower into a 59" long, 16" diameter, 325 pound frame — are 16 precision built steel spray nozzles.

These are special nozzles, developed for the engine by Spraco engineers. Their critical function: to feed just-right amounts of fuel into the combustion chamber.

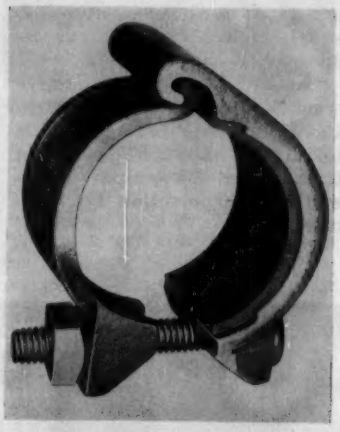
This development is another example of the hand-in-glove cooperation, engineering service, and product quality you can expect from Spraco whenever you have a spray nozzle problem.

FREE—*The most complete spray nozzle catalog ever published. Send for your copy today!*

SPRAY ENGINEERING COMPANY,
115 Cambridge Street, Burlington, Mass.

SPRACO

bundle conforms to any surface. Air, continuously flowing over working surface, removes loosened particles. Needle life is about 500 hrs. on metal surfaces. Nonsparking needles also available.—**The Marindus Co., New York, N. Y.** 165A



Emergency Pipe Clamp

Simple first aid for leaking process piping.

Installation of the new Junior emergency pipe clamp is quick and simple. Just place clamp around the pipe with its gasketed half against the leak; then tighten bolt nut—the leak is fixed.

Companion to the older two-bolt model, the Junior features rugged malleable iron construction and a slotted lug on the gasket half for speedier bolting. Now available for 2-in. pipe, the clamp will soon be offered for 2½-, 3-in. sizes.—**M. B. Skinner Co., South Bend, Ind.** 166A

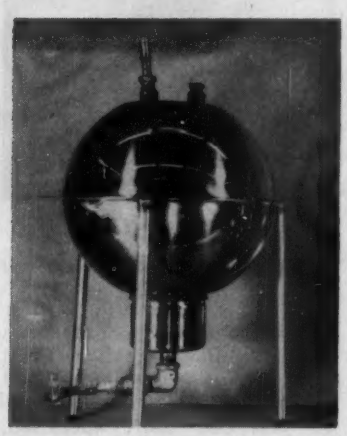
Bacteria Incubator

Research apparatus grows micro-organisms.

Designed to grow large quantities of bacteria, yeasts, molds and other micro-organisms, a new machine may prove a valuable aid to many industrial research projects. Equipped with a special aeration agitator, the unit consists essentially of a double-walled cylindrical chamber, 16 in. wide and 30 in. long. Instruments mounted on the

front of the housing cabinet control performance.

In operation, Biogen, as the machine is known, provides the ideal growing conditions essential to a rapid growth of the organisms in a sterile medium of mineral salts and sugars. The controls automatically withdraw the culture when it reaches desired population, and then inject fresh sterile medium.—**American Sterilizer Co., Erie, Pa.** 166B



Ultrasonic Degasser

New tool for processing; more to follow.

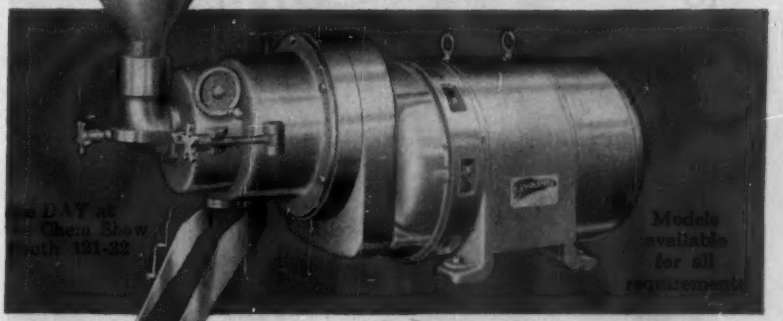
Pictured above is a pilot-plant model of equipment for ultrasonically degassing boiler feedwater. The manufacturer, after extensive semiworks investigation of the degasser, is now offering built-to-order units for large-scale processing.

Cavitational effects, induced by one or more electronically driven transducers spaced at strategic locations around the vessel, "jar" the dissolved gases from solution. A vacuum pump removes resultant bubbles from the vessel.

In application, two or more degassers, acting in tandem as intermediate holding tanks, will permit degassification of almost unlimited liquid flows to process equipment. Number of tanks, their size, and process characteristics will determine actual capacity. The manufacturer is also experimenting with continuous pipeline degassers, as well as ultrasonic equipment

DAY Hy-R-Speed Mills

cut your costs 3 ways



DAY Hy-R-Speed Mills insure economical, fast, quality production, and you save 3 ways:

1. **YOU SAVE ON CAPITAL INVESTMENT.** Its attractive price is a result of simplicity of design, a minimum of moving parts. It's built for years of dependable service.
2. **YOU SAVE ON OPERATION COST.** No skilled operator required. Complete clean-up requires less than 5 minutes. Precise particle size controlled by simple adjustment of stationary stone. Gives 4 times the production of ordinary mills.
3. **YOU SAVE ON MAINTENANCE.** Contact parts are rust proof. Stator and rotor stones are interchangeable, reducing inventory needs. Has record for dependable operation.

If you disperse paints, chemicals, inks, plastics or food products, it will pay you to use a Day Hy-R-Speed Mill. Make Day your one source for process equipment.

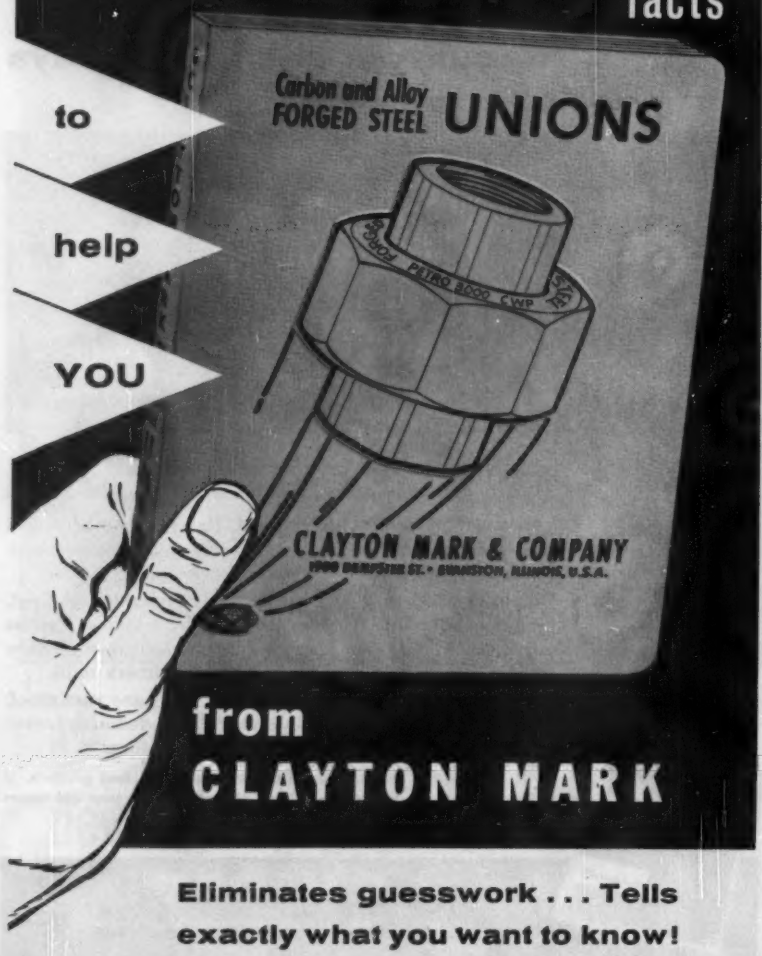
Write for new bulletin

The J. H. DAY Co. Division of The Cleveland Automatic Machine Co.

The J. H. DAY Co. *Division of The Cleveland Automatic Machine Co.,*
4926 BEECH STREET, CINCINNATI 12, OHIO

more new FORGED STEEL UNION facts

to help YOU



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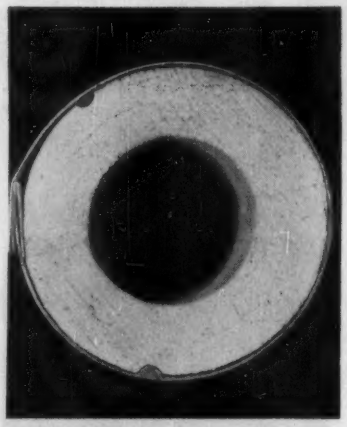
1900 Dempster St., Evanston, Ill.
quality products for industry, farm and home

Since 1888

for descaling, polymerizing and smoke precipitation — **Narda Ultrasonics Corp., Westbury, N. Y.** 167A



Pipe Insulation

Insulation plus jacket goes on in just 90 sec.

Contractors and maintenance men can now install calcium silicate pipe insulation as well as a protective aluminum jacket in just one short operation. From package to pipe, typical insulating time per 36-in. section is claimed to be only 90 sec. A portable saber saw, or even a hacksaw, quickly cuts Metal-On insulation for fitting around pipe supports, hangers and joints.

Designed for temperatures to 1,200 F., the insulation is available in a complete range of sizes—up to 3 in. thick for pipe to 24 in. dia. A vapor barrier separates jacketing from insulation. Installation consists of snapping the sections onto the pipe and sealing joints with metal "snap-straps" held in place by metal bands.—**Johns-Manville, New York, N. Y.** 168A

Spray Gun

Unit simplifies installation of insulation.

Selling for $1,200, a new industrial spray gun applies a rigid urethane foam as insulation over large areas or structural panels. Final costs are comparable to those for stand-

ard insulation. Continuously operating, the gun can build up thicknesses from 3/16 to 2 in.; foam adheres to vertical and overhead surfaces without sagging.

Two resins, each mixed with other components, atomize and mix in the spraying operation. Foaming action occurs immediately, even before the mass strikes the surface. Setting is complete in 60 sec. Raw materials do not contact within the gun; as a result, no buildup occurs on critical sprayer surfaces.—**Devilbiss Co., Toledo, Ohio.** **168B**

BRIEFS

Ball valves, known as Style H of the manufacturer's Double-Seal line, are designed for high-pressure or high-vacuum applications. Unit-body construction renders valves virtually leakproof. Sizes from ¼ to 2 in.—**Jamesbury Corp., Worcester, Mass.** **169A**

Heat exchangers, offered in sizes from 1.3 to 200 sq. ft., feature a design that prevents bypass around the tube bundle, thus improving efficiency by 10-15%. One-, two- and four-pass models.—**Perfex Corp., Milwaukee, Wis.** **169B**

Expansion joints and flexible couplings for process lines consist of a flange-mounted, glass-fiber-reinforced silicone casing with a heavy molded Teflon inner liner. Rated at 150 psi., the units come in sizes for ½ to 6-in. pipe.—**Chicago Gasket Co., Chicago, Ill.** **169C**

Atomizing nozzles produce fine, uniformly dispersed, hollow-cone sprays. Stocked in bronze and stainless steels, the nozzles are available in 15 orifice sizes providing a wide range of capacities to about 3 gpm.—**Schutte and Koerting Co., Cornwells Heights, Pa.** **169D**

Nitrogen generator, compact and capable of producing more than 4 l./hr. of 99.5%-pure liquid nitrogen, operates for continuous periods of up

PITT-CONSOL

META PARA CRESOL

higher in META content by 3 to 1

Pitt-Consol META PARA CRESOL has 2.7 parts of meta to every one of para . . . more meta cresol (over 70%) than most mp cresols on the market today! Offered in 2° and 3° grades of high purity and closely controlled uniformity, this phenolic product is unique . . . shows great promise for new phenolic resin applications.

Pitt-Consol META PARA CRESOL is part of a full line of high quality phenols, cresols and cresylic acids produced by our continuous extraction process. Whether you seek high meta content in mp cresols or high quality in any cresylic acid, look to Pitt-Consol first.

Consult our insert in Chemical Materials Catalog or write for your file copy.

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PITT-CONSOL CHEMICALS

A SUBSIDIARY OF CONSOLIDATION COAL COMPANY

This NUGENT FILTER will handle pressures to 3000 P.S.I.

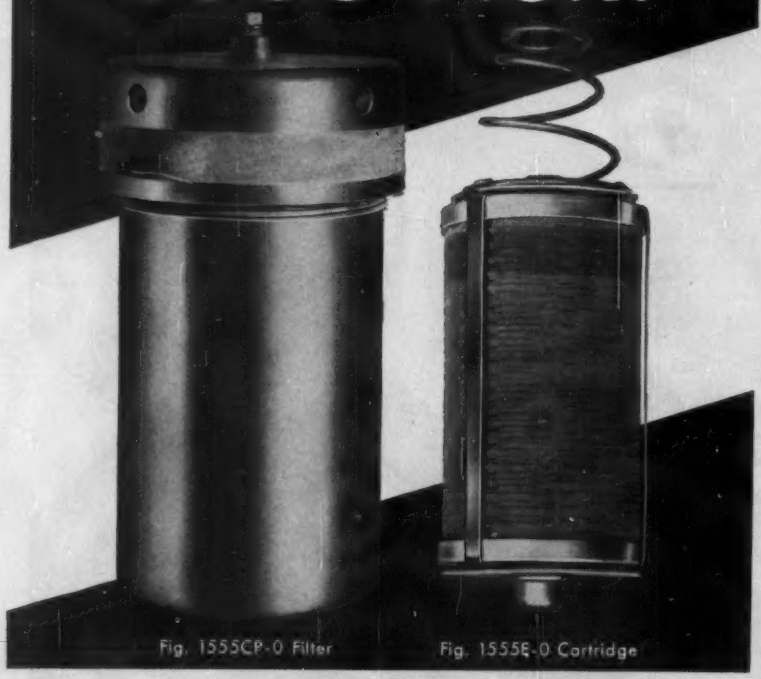

Fig. 1555CP-0 Filter Fig. 1555E-0 Cartridge

Here's big news from the pioneer of fluid filtration. The Nugent Co. introduces the latest addition to their line of fine products . . . a completely new series of Laminated Fiber Disc Filters. Designated as 1555CP, they are designed for hydraulic and other high pressure applications.

Constructed for 3000 psi working pressure, they comply with the requirements of the ASME Code for Unfired Pressure Vessels. API or ASME code inspection and stamping is available.

Five sizes are available with capacities ranging from 1.5 GPM at 3 psi pressure drop to 47.6 GPM at 6 psi pressure drop when filtering 100 SSU viscosity mineral oil. For installations requiring larger capacity, the filters may be connected in multiple. Inlet, outlet and drain are located in the bottom of the filter.

For complete information on 1555CP filters, write today . . . or if your job is *RUSH*, phone ORchard 4-8121, Skokie, Illinois. Our engineers will help you.

ESTABLISHED 1897

REPRESENTATIVES IN PRINCIPAL CITIES

WM. W. NUGENT & CO., INC.

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OIL FILTERS • STRAINERS • TELESCOPIC OILERS
OILING AND FILTERING SYSTEMS • OILING DEVICES
SIGHT FEED VALVES • FLOW INDICATORS

to 200 hr. Unit has no moving parts, and occupies only 20 x 72 in. of floor space.—**Philips Electronics, Inc., Mount Vernon, N. Y. 169E**

Generator, which delivers up to 5,000 lb./hr. steam from an over-all floor area of 8x7 ft., is completely controlled by electronic instrumentation. Claimed to be entirely reliable and efficient under the most severe operating conditions.—**Cyclotherm, Oswego, N. Y. 170A**

Steam trap, engineered especially for light condensate load applications, gives extremely economical operation. For ½-in. lines and pressures from 8 to 600 psig., the trap has only one moving part and stainless steel construction. —**Yarnall-Waring Co., Philadelphia, Pa. 170B**

Equipment Cost Indexes . . .

	March 1958	June 1958
Industry		
Avg. of all	231.2	230.7
Process Industries		
Cement mfg.	222.9	222.2
Chemical	232.4	231.7
Clay products	216.6	216.0
Glass mfg.	219.4	218.8
Paint mfg.	223.8	223.1
Paper mfg.	223.9	223.3
Petroleum ind.	228.6	227.9
Rubber ind.	231.4	230.7
Process ind. avg.	228.8	228.2
Related Industries		
Elec. power equip.	234.2	234.3
Mining, milling	233.8	233.1
Refrigerating	261.5	260.7
Steam power	219.5	218.4

Compiled quarterly by Marshall and Stevens, Inc. of Ill., Chicago for 47 different industries. See Chem. Eng., Nov. 1947, pp. 125-6 for method of obtaining index numbers; Feb. 24, 1958, pp. 143-4 for annual averages since 1913.

For More Information . . .

about any item in this department, circle its code number on the

Reader Service

postcard (p. 191)

A word to the refractory-wise:

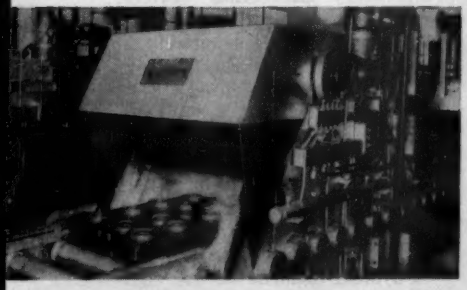
The recession is fading fast... are you ready for the rebound?

Industry is on the move again. But management has learned valuable lessons from the recession. In the future they will exercise extremely *close* control of costs. To satisfy this sharp-eyed attitude, unit costs and prices must be brought down to a rock-bottom low. So make sure *your furnaces* can help cut production costs. Make sure your furnaces are ready *now* to operate at peak efficiency during the months to come.

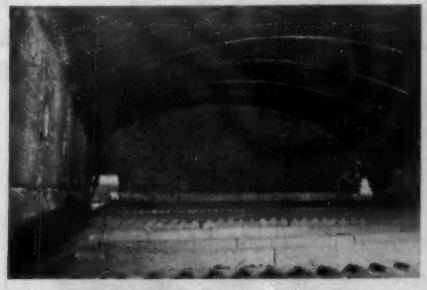
Consider the "vulnerable" areas in your furnace, for example — areas subjected to flame impingement or heavy loads, or exposed to abrasion or corrosion. Or other working areas where heat must pass *through* the refractory. These are the areas where you can substantially cut production costs — particularly if you use one of our special-purpose Super Refractory materials. The three examples on this page show how *large* these savings can be.

HERE'S HOW YOU CAN START CUTTING COSTS:

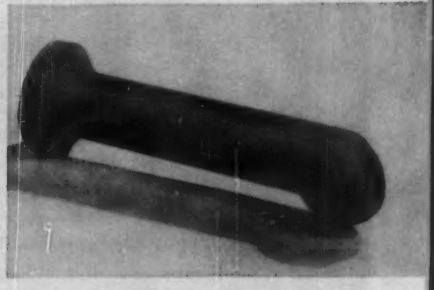
it will take less than an hour to read these two booklets about the applications—and properties—of Carborundum's unique, new super refractories. Send for them today, to Refractories Div. Carborundum Company, Perth Amboy, N. J., Dept. H-118.



LAST 5 TIMES AS LONG. In this high temperature atmosphere furnace, parts travel through on a cycle from cold to 2100°F to cold in 1 hour and 10 minutes. Metal fixtures warped, stuck to parts. Thicker fixtures absorbed furnace heat. Super Refractory fixtures outlasted the alloy 5 to 1, cut weight, ended sticking, and cost less as well.



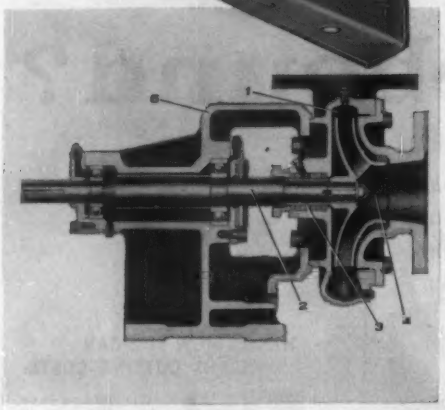
STOP ALL MAINTENANCE FOR 2 YEARS. Notches in this walking beam furnace lasted 4 to 6 months, and furnace had to be shut down almost weekly for repair on the notches (on which bars being heated rest). When Super Refractory rests were installed, the furnace ran for 2 years without any repair at all, and ran another year with only 10% replacement. Cost? Less than half that of alloy.



HANDLES CHEMICAL ATTACK FOR 5 YEARS. This nozzle sprays 150°F acid into an absorbing chamber where gases are at 1800°F. This Super Refractory easily withstands this tough combination of both corrosion and sharp temperature gradient, and lasts over 5 years, compared to 2 months for metal.

CARBORUNDUM

Registered Trade Mark



5 WAYS this Weinman Pump ends your industrial pumping problems

Here's how to lick your pumping worries fast. Weinman Type GB single stage, end suction centrifugal pumps handle all kinds of tough jobs easily, efficiently. These 5 design features tell why.

1. Streamlined volute handles 10 to 2000 gpm efficiently. Tenoned into power frame for perfect alignment.
2. Sturdy, large-size shaft is accurately machined and finished to eliminate deflection and vibration. Assures long, trouble-free life.
3. Bronze, hardened or other non-corrosive sleeves protect shaft in stuffing box. Six rings of packing are used.
4. Available with either enclosed (above) or open impeller. Both are designed for high operating efficiency, low mechanical and hydraulic losses.
5. Rugged, 1-piece cast iron power frame.

You can get this same efficient, trouble-free performance in other Weinman pumps. Whatever your pumping requirements, chances are that a Weinman pump can give you better performance at lower cost. For information about the complete Weinman pump line, write for free bulletins. Or, call your Weinman pump specialist—he's in the Yellow Pages of your telephone directory.

See your Weinman pump specialist

THE WEINMAN PUMP MFG. CO.
CENTRIFUGAL SPECIALISTS

TECHNICAL

Gets to the Core

INDUSTRIAL HYGIENE AND TOXICOLOGY, VOL. I, 2nd ed. Edited by Frank A. Patty. Interscience Publishers, Inc., New York. 830 pages. $17.50.

Reviewed by Alvin Davis, Department of Preventive Medicine and Industrial Health, University of Cincinnati, Cincinnati, Ohio.

Revision of Frank Patty's original work consists of 21 chapters, each concerned with a major facet of industrial health and safety. Mr. Patty has authored five of the chapters, and the remainder are contributed by 17 other distinguished names in the field.

Inasmuch as the field of industrial health is interdisciplinary, both engineering and medical aspects are included and the authors similarly represent a variety of backgrounds.

Every engineer concerned with process design and production should be particularly interested in Patty's chapters on modes of entry and action of toxic materials, sampling and analysis of atmospheric contaminants, and respiratory protection devices. These areas represent the core of industrial hygiene activity in the chemical industries and are extremely well presented.

Chapters by W. N. Witheredge on air cleaning and ventilation, and by George D. Clayton on air pollution should be of special interest to those persons responsible for control of dissemination of toxic materials.

Physical hazards of the environment are discussed in chapters on heat control by T. W. Hatch, radiant energy by Leon F. Curtiss, industrial noise by Jerome R. Cox, Jr., and abnormal atmospheric pressure by Heinz Specht.

This volume can be recommended highly as a general source of information concerning the physical and chemical hazards of the industrial environment.

BOOKSHELF

J. B. BACON

BRIEFLY NOTED

API RECOMMENDED PRACTICE FOR INSPECTION, REPAIR AND RATING OF UNFIRED PRESSURE VESSELS IN SERVICE IN PETROLEUM REFINERIES (RP 510) 20*pp. Publications Dept., American Petroleum Institute, 50 W. 50 St., New York 20, N. Y.* $1. Covers inspection, repair, evaluation for continued use and methods for computing maximum allowable working pressure of unfired pressure vessels.

CORROSION OF OIL AND GAS WELL EQUIPMENT. 96 *pp. Production Office, American Petroleum Institute, 300 Corrigan Tower Bldg., Dallas, Tex.* $2.50. Developed jointly by API and NACE, publication covers general aspects of corrosion, details methods of evaluation and control.

DIRECTORY OF THE AMERICAN COUNCIL OF INDEPENDENT LABORATORIES, INC., 7th ed. *H. M. Dudley, Executive Secretary, American Council of Independent Laboratories, Inc., 4302 East-West Highway, Washington 14, D. C. (Requests should be on Company letterhead signed by a company executive.)* No charge. Lists 500 individual services performed by one or more leading testing and research laboratories in the country.

LIST OF U. S. TECHNICAL PAPERS PRESENTED AT SECOND UNITED NATIONS INTERNATIONAL CONFERENCE ON THE PEACEFUL USES OF ATOMIC ENERGY. 16 *pp. Office of Technical Services, U. S. Dept. of Commerce, Washington 25, D. C.* 25¢. Lists the more than 600 U. S. papers offered at the Geneva conference, Sept. 1-13.

MORE NEW BOOKS

AUTOMATIC MEASUREMENT OF QUALITY IN PROCESS PLANTS. Edited by the Society of Instrument Technology. Academic Press. $9.50.

SOME PROBLEMS IN CHEMICAL KINETICS AND REACTIVITY, Vol. 1. By N. N. Semenoy. Princeton University Press. $4.50.

STOICHIOMETRY FOR CHEMICAL ENGINEERS. By Edwin T. Williams and R. Curtis Johnson. McGraw-Hill. $8.

"International"
Slow Speed Mixers
WITH NEW SIMPLIFIED PACKAGE MOTOR REDUCER DRIVE

STANDARD NEMA FRAME MOTOR COUPLED TO THE GEAR UNIT
"International"
TYPE LWR
Right angle Drive
With New
PACKAGE MOTOR
REDUCER DRIVE
1 to 30 HP
LOW SPEED CAGE WITH CHANGE GEAR AND SPIRAL BEVEL GEAR CAGE IN SEPARATE PACKAGE UNITS FOR EASY REMOVAL WITH WRENCH

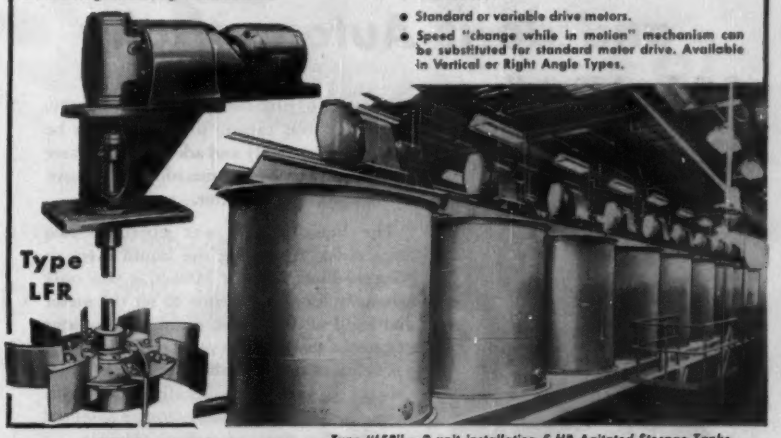
IN VERTICAL AND RIGHT ANGLE TYPES—"International" Package Reducers and Integral Gear Motors provide a brand new, economical and practical answer to most of the problems of Mixer Drive-Head operations. Ratio changes are made in the High Speed Gear Set, ahead of the low speed set, both of which are assembled into a rigid cast iron cage. This subassembly is a complete unit, with gears and bearings, providing easy removal and assessibility.

COMPLETELY INTERCHANGEABLE

No special tools or machine operations required for gear ratio change. Standardized parts provide quick change and low maintenance. Vertical mixer shaft speeds from 1.8 RPM to 230 RPM. HP range from 1 to 30. Uses any standard motor. Long span between bearings insures mixer shaft rigidity. Quiet operation because of ground tooth gears. SPLINED SHAFTS and GEARS provide positive ratio change of gears. Ample overhung load capacity. Positive lubrication. Positive Mechanical Type Oil Seal. Drive head furnished with or without a welded pedestal. Particularly adapted to Turbine operation. Highest Mechanical Efficiency. Ask for Special Bulletin.

International — Type LFR — SLOW SPEED

- Uses any standard motor, Low Head room.
- Mechanical efficiency 96 to 98½%.
- Speed ranges 1 to 350 RPM.
- Interchangeable speeds.
- All steel gear housing—unbreakable.
- Wide bearing spans increase shaft rigidity.
- Quiet in operation. AGMA ratings.
- 100% starting and momentary overloads.
- Closed or open vessel operation.
- 1 to 100 H.P.
- Standard or variable drive motors.
- Speed "change while in motion" mechanism can be substituted for standard motor drive. Available in Vertical or Right Angle Types.



Type "LFR"—9 unit installation 5 HP Agitated Storage Tanks

MFRS. OF CHEMICAL PROCESSING EQUIPMENT, INDUSTRIAL FANS, STACK FANS, AXIAL BLOWERS, BRICK, TILE AND CERAMIC MACHINERY
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Put your processing problems up to "International" Engineering, Inc.

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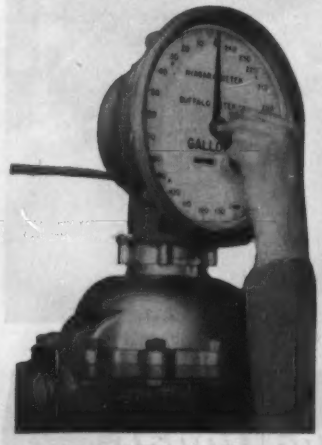
HOW TO METER
Hard to Handle Liquids

Bottle washing plant of large brewery

and do it Automatically

Set for 175 Gallons



Get 175 Gallons

That *was* the problem at a large brewery. The liquid was caustic soda. It had to be measured accurately and added to the water in the bottle-washing machine to remove labels and foreign matter.

The liquid caustic was stored in two large tanks. By piping the liquid through Niagara Electricontact Meters, it was only necessary for the operator to set the meter dial hand to the desired number of gallons of caustic, then press a push button to start the delivery to the washing machine. Upon delivery of the preset quantity, the switch in the Electricontact Meter closes a solenoid to stop the flow of caustic. Simple . . . accurate . . . and fool-proof!

Let us show you how to solve your liquid metering problem to give you cost-saving, time-saving accuracy by automation. Write for complete information.

BUFFALO METER CO.

2891 MAIN STREET • BUFFALO 14, NEW YORK

LETTERS:

What Is a Ceramic?

Sir:

I have just read your feature report on "Nonmetallic Inorganics" in the Sept. 8 issue (pp. 123-134). I should like to compliment you on a fine article that is a worthwhile contribution to the engineering literature.

I do, however, object to its title. It seems to be a roundabout way of saying "ceramics." Actually, all the materials in your table are ceramic materials or (as in the case of cermets) they contain a substantial amount of ceramic materials.

Those of us in the ceramic industry have a difficult job in getting the word "ceramic" understood and properly used. It seems to me that your article should have had the word "ceramics" in its title. In reality, your term "nonmetallic inorganics" is one way of defining ceramics.

W. A. DERINGER
National Institute of Ceramic Engineers
Columbus, Ohio

▶ *Our choice of title for this feature report was deliberate. To many engineers, the word "ceramic" means either "pots" or "bricks." Traditional definitions of and uses for construction materials no longer hold in today's fast-moving technology. Even ceramists disagree among themselves as to the definition of a "ceramic" material. Our "nonmetallic inorganics" is sufficiently broad to include conventional ceramics as well as other materials which may not be classed as ceramics.*—ED.

PRO & CON

C. H. CHILTON

Move the Decimal Point

Sir:

I have just finished reading your Sept. 8 article, "Speed Trial and Error Solution for Pipe Diameter" (pp. 138-140) and found it clear, straightforward and practical.

However, there are two errors that I would like to bring to your attention. On p. 140, in the calculations for the third trial, ϵ/D should read 0.000438 and D would then be 0.334 or 4 in. These are only errors in decimal place but they could lead to confusion in reading the chart.

WALTER V. WILSON
Shell Chemical Corp.
Deer Park, Texas

▶ *Our thanks to sharp-eyed readers like Mr. Wilson for keeping our decimal-misplacing editors on their toes.*—ED.

Pro: Old Trick

Sir:

In your Plant Notebook article, "Old Trick Averts Error in Figuring Dilution" (Sept. 8, pp. 149-150), the final equation should read $(15/35)100 = 42.8$.

We have used this "trick" in our work for some time and are pleased to see it come to light again.

A. E. FALVEY
Minerals & Chemicals Corp. of America
McIntyre, Ga.

Pro: High-Quality Engineers

Sir:

Mr. Vasey's letter in your July 14 issue (p. 182) implies that the AIChE Career Guidance Committee is bringing "great pressures" to bear upon young people to encourage them to enter fields of science and engineering.

This is not true. Our committee is firmly committed to the principle that our main objective is to improve quality in candidates interested in studying for the chemical engineering profession. Our further objective is to supply information which will

ROLOCK

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Illustration shows one of many special large fabrications typical of this type of equipment made by Rolock. This bell is of 3/8" Inconel and, together with its base, incorporates a number of unusual features. Rolock is equipped to build and test such equipment to customer's exact specifications.

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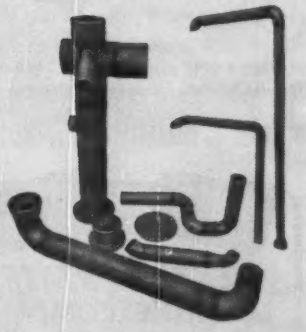
Illustrated are typical special tubing and flange forms fabricated by Rolock to customer's specifications. Special equipment and skills required for this type of work are available at Rolock, together with engineering assistance when required.



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assist young people in deciding whether or not they are interested in entering this field.

We do not propagandize or proselytize to increase the membership in our profession or our society. Our function is "guidance," and toward that end we will do everything in our power to inform students concerning our profession and to encourage their entrance into it, if they are properly qualified and have no over-reaching interest in another field.

RAPHAEL KATZEN
Cincinnati, Ohio

Pro: Batch Processing Costs

Sir:

I have just finished reading Mr. Hindman's letter in your April 21 issue (p. 194) on cost accounting for small chemical plants with batch processing.

Let me add my very hearty endorsement to his views. We are faced with exactly the same situation and find very little reference material available.

If you can see your way clear to doing it, an article or series of articles on engineering economics for the small plant would be most helpful. Particularly of interest would be methods for allocating costs to batch processes. This might cover batches processed intermittently as well as the use of the same equipment and labor for different batches during the same day.

MAX HALEBSKY
Earle & Mattin
Peekskill, N. Y.

► *We'd be glad to hear from CE readers who are able and willing to contribute any articles along the lines suggested by Mr. Halebsky. One such article, dealing with joint and byproduct costing, is already on our publication schedule.*—ED.

Eliminate the Middleman

Sir:

I read with interest your *Chementator* article (Aug. 25, p. 53) in which you mention a new and shorter route to nuclear fuel as now being practiced by Davison Chemical Co.

It is my understanding that all companies licensed by the Atomic Energy Commission now pur-

chase ore mill concentrates, and we certainly found this to be true. Furthermore, we have been processing ore mill concentrates to a ceramic-grade uranium dioxide for quite some time.

We would be quite surprised if at least two other chemical processors of uranium compounds are not able to do the same thing. I do not believe Davison has developed anything new and novel that is not being practiced by the entire industry.

H. R. DINGES
Spencer Chemical Co.
Kansas City, Mo.

► *Our story did not state that Davison had developed anything novel or unique; that inference was incorrectly drawn by Mr. Dinges.*

Davison does claim the distinction of being the first company licensed by AEC to purchase uranium concentrates in quantity directly from the mill in an entirely private transaction. Until recently, AEC played the role of middleman in all uranium concentrate buying and selling.—ED.

So What's New?

Sir:

I noted with interest your Design Notebook article (Aug. 25, p. 131) which describes the eductor mixing of air with steam as a "new" way to reduce noise and vibration in live steam heating.

We published this identical method in an article in *Applied Microbiology* earlier this year.

GEORGE J. FULD
Massachusetts Institute of Technology
Cambridge, Mass.

► *While Prof. Fuld's article appeared several months before ours, we both lose any claim to originality in view of the following evidence.*—ED.

Sir:

Relative to the winning Design Notebook article by J. F. Kuong, we call your attention to the enclosed copies of pages 4216-4217 from the Schutte & Koerting general catalog of the 1930's.

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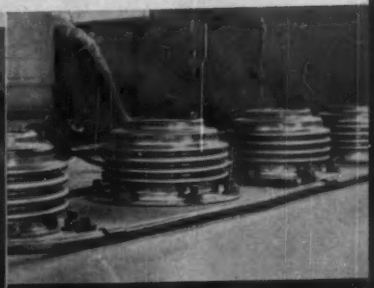

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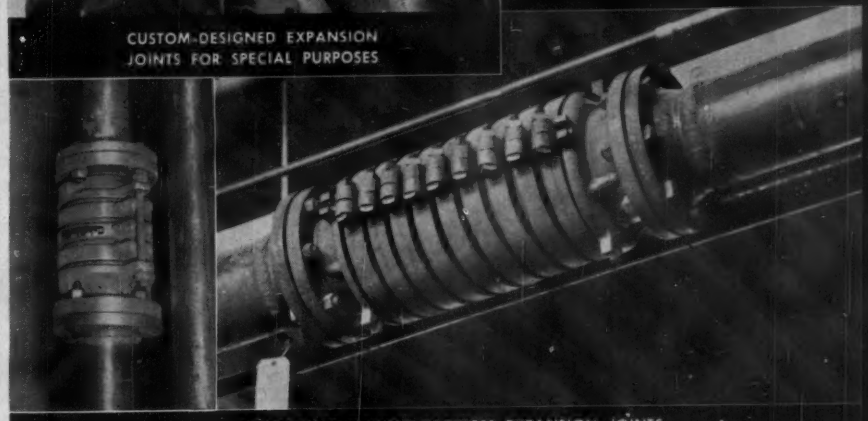

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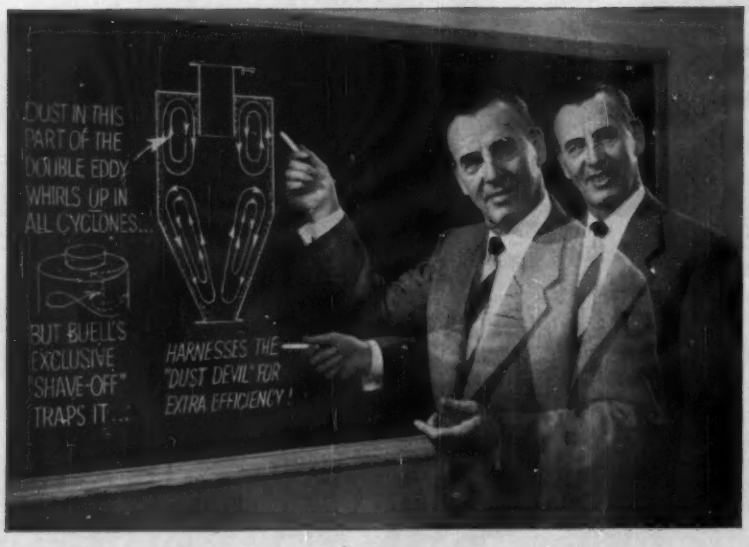
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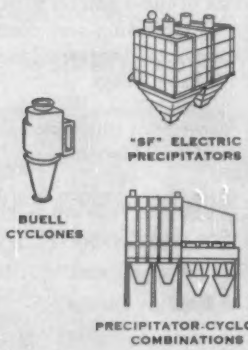

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Chemical Engineering

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STARTS ON PAGE 180

Conduit box can be located top, bottom, or either side.
Control hand wheel can be positioned on top or either side.
All end-bracket assemblies are interchangeable for repositioning of drive components.
GET ALL THESE VARIATIONS FROM ONE BASIC DESIGN
— with wrench and screwdriver!
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tar'i-an-ism (ō-thôr'i-târ'i-ăn
au-thor'i-ta'tive (ō-thŏr'i-tā'tĭ
from, authority; entitled to ob
thoritative teachings. 2. Ha
peremptory. — au-thor'i-ta'tiv
au-thor'i-ty (ō-thŏr'i-tĭ), *n.*; *p*
auctoritas.] 1. Legal or rigi
a particular field; as, the Port
in support of opinic
ony; witness. b A prec
thor. d Just
influence of
like. — Syn.
-thŏr-i-zā'shŭn
(ō'thĕr-īz), *v. t.* 1
commission; as, *authc*
act.
precedent sanction; as, customs
und for. — au'th
a-thor-ized (ō'thĕr-īzd), *adj.* 2
hority. b Sanctioned or appro

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TECHNICAL

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Chemicals

Adhesive.....2 p. leaflet on Thixon NM, a rubber-to-metal bonding agent, contains sections on function, composition, properties, application.
180A Harwick Standard Chemical Co.

Alkyds, Methacrylated.....6 p. data sheet describes processes for copolymerization of methacrylates with alkyd resins. Reaction data for unusual products.
180B Rohm & Haas Co.

Chemicals.....4 p. catalog, "Chemicals for Research," contains brief descriptions and specifications for 28 different research and specialty chemicals.
180C Ansul Chemical Co.

Chemicals.....Complete information on Phosphoric Anhydride, Lauryl Chloride, Caustic Potash and 1,2,4,5-Tetrachlorobenzene is available on request.
91 *Hooker Chemical Corp.

Chlorates.....Large safety wall charts describes proper handling of chlorate and perchlorate chemicals used in matches, fuses and flares, weed killers, etc.
180D American Potash & Chemical

Clays.....10 p. bulletin TSBT-84 contains detailed data on new REA series of resin-treated clays. Includes graphs, tables on properties, performance.
180E Georgia Kaolin Co

Ethylene Glycol.....20 p. manual describes an aqueous ethylene glycol solution, Dowtherm SR-1, a heat transfer fluid designed for snow melting installations.
180F Dow Chemical Co.

Fluorides.....Company offers a copy of M. C. A. Chemical Safety Data Sheet SD-25 on properties & essential information about hydrofluoric acid, anhydrous & aqueous.
86 *The Harshaw Chemical Co.

* From advertisement, this issue

LITERATURE

E. M. FLYNN

Furfural.....To calculate what furfural can do for you, write for information. Physical properties and other data available on your request.
71 *Quaker Oats Co., Chem. Div.

Lubricants.....16 p. pocket-size folder describes general and specialty lubricants, greases, mine lubricants, diesel lubricating oils, hydraulic oils.
181A Sun Oil Co.

Marasperses.....A 23-page booklet features charts, illustrations, and applications of chemical & physical characteristics of the Marasperses.
181B Marathon Corp.

Meta Para Cresol.....is part of a full line of high quality phenols, cresols & cresylic acids produced by continuous extraction process. Data available.
169 *Pitt-Consol Chemical Co.

Oleic Acid.....1 p. bulletin 103 describes a high quality double-distilled type red oil, high in oleic acid content. Specifications, uses.
181C Arnold, Hoffman & Co.

Paints, Alkyd.....Handy cardboard calculator called the "Alkyd Formulator" has 3 movable slides and 9 calibrated scales to speed up formulation of alkyd systems.
181D Heyden Newport Chemical Corp.

Resins, Fluorocarbon.....Pipe lined with Teflon TFE resins minimize maintenance & downtime in chemical services. It won't shatter under vibration. Information available.
15 *E. I. du Pont de Nemours & Co.

Silicones.....16 p. portfolio on silicone intermediate Z-6018 which adds moisture and weather resistance to resins contains applications, properties, formulations.
181E Dow Corning Corp.

Solvent.....High boiling EAK for use in a variety of surface coating formulations. A catalog of solvents, resins & intermediates, "Organic Chemicals" available.
Cover *Shell Chemical Corp.

* From advertisement, this issue

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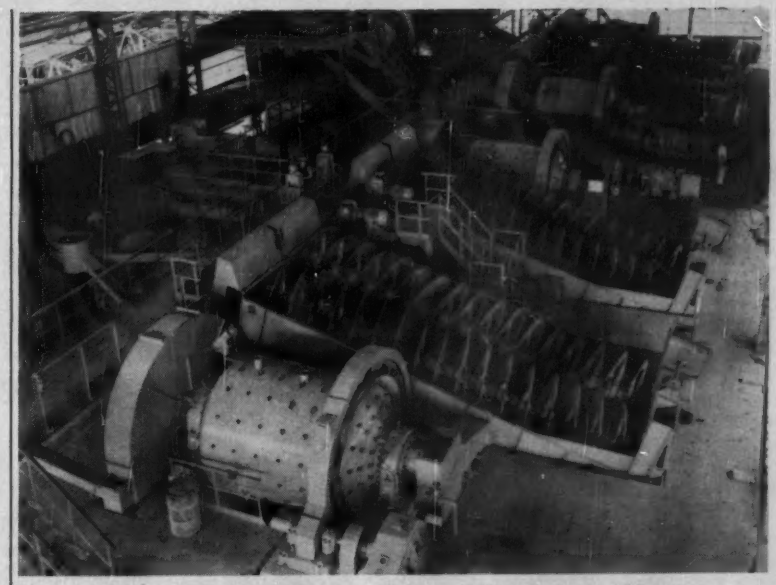
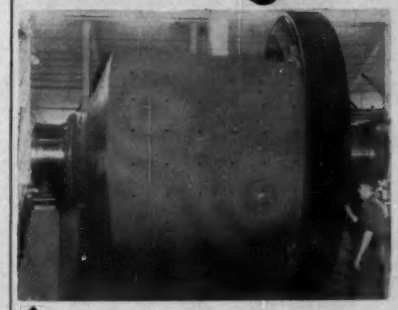


Shown here are four Hardinge 9-3-6-8 Tricone Mills grinding sulfide copper ores and mixed ores in a concentrating plant in the Belgian Congo, Africa.

CORRECT BALL SEGREGATION in the HardingeTRICONE MILLS



Shop view of a 10½′ Tricone with 9′ long tapered shell.

Highest grinding efficiency and lowest ball and lining wear are common to mills with a correctly segregated ball charge. The Hardinge Tricone Mill is the only mill providing these essentials to low cost operation without the use of special linings or internal devices, which are subject to wear and are effective through only a part of their wearing life.

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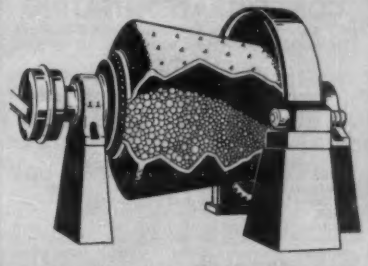

Complete specifications upon request. Bulletin AH-414-11

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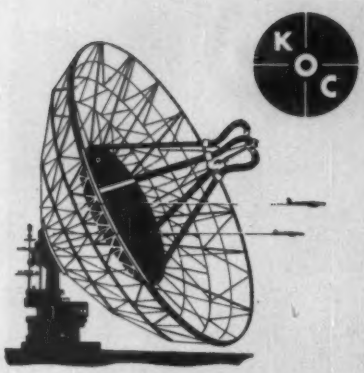

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LITERATURE . . .

Urethanes.....6 p. booklet presents latest formulations and requirements for foamed-in-place applications of rigid urethane foam in structural materials, insulation.
182A Allied Chemical Co.

Water....."Ultra-Pure Water, Prime Requisite for Nuclear Power Plant Cycles," 4 p. bulletin T-162, discusses reason for extreme purity needs in nuclear cycles.
182B Graver Water Conditioning Co.

Zirconium Hydride.....4 p. data sheet gives physical and chemical properties and application information on Nuclear Grade R and Commercial Grade C.
182C Metal Hydrides Inc.

Construction Materials

Alloy Fabrication....."Guide For Purchasing Complex and Unusual Alloy Sheet and Light Plate Fabrication" is now available. Detailed descriptions of fabrication.
182D S. Blickman, Inc.

Aluminum.....A 36-page book, "Alcoa Aluminum Industrial Building Products" gives technical information on corrosion resistance, economy, strength & insulating value.
57 *Aluminum Co. of America

Chromium Oxides.....are most stable of the green pigments, unaffected by acids, alkalis, vehicles & solvents. Tech. data on 4 pure & 2 hydrated chromium oxides offered.
161 *C. K. Williams & Co.

Coatings, Dispersion.....Halofluorocarbon coating system offers corrosion engineers a combination of properties; thermal stability, dielectric strength, etc. Bulletin.
182E Minnesota Mining & Mfg. Co.

Crucibles.....available in a wide range of materials, sizes & types. A new catalog "Norton Refractory Crucibles," is available with further facts.
73 Norton Co.

Cylinder, Air Dryer.....X-rayed & stress relieved. All plant equipment is geared to capacity for welding 2-inch-thick material & lifting 80 tons. Bulletins.
13 *Dowington Iron Works, Inc.

Fabrication.....Steel & alloy plate fabrication from ¼" to 1¼". Experienced and skilled to custom fabricate to your needs or special requirements.
75 *Missouri Boiler & Tank Co.

Fabrication Pipe.....A specialized activity at Vulcan is now offered. All work supervised by master metalsmiths on manifolds, jacketed or lined piping.
6-7 Vulcan-Cincinnati

Industrial Building Products.....require practically no maintenance & serve well even when exposed to corrosive atmospheres around processing areas. Bul. AD 285.
182F Aluminum Co. of America

Insulation, Blanket.....is ready for installation and easily conforms to surfaces. Gives maximum thermal efficiency at temperatures as high as 1200F.
32 *The Eagle-Picher Co.

* From advertisement, this issue

PUMP PROBLEMS write **TABER**

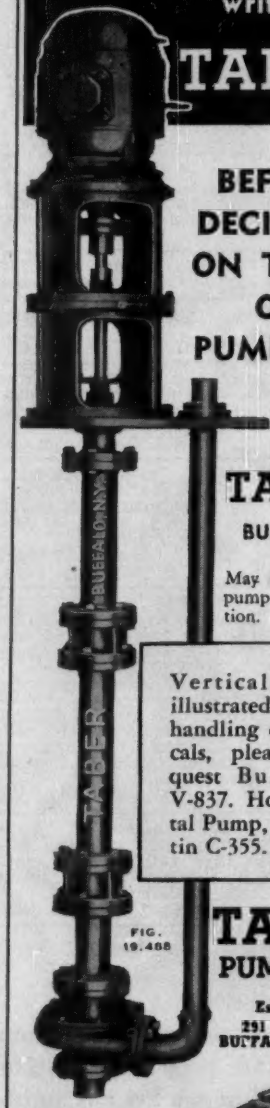

FIG. 19.408

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May avoid costly pump misapplication.

Vertical pump illustrated, for handling chemicals, please request Bulletin V-837. Horizontal Pump, Bulletin C-355.

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FIG. 6061

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Linings, Plastic.....Tygon, flexible, plastic linings offer top corrosion resistance. Booklet tells facts about Tygon, where & how to use it. Send for your copy.
46 *U. S. Stoneware

Platinum Salts.....A complete list of platinum and platinum group salts and solutions is available on request. Other products include stainless steel & nickel tubing.
L196 *J. Bishop & Co.

Rubber, Butyl.....is the ideal material for wire & power cable, transformers, tapes, busbars & other insulation applications. Resists weather, chemicals, etc. Data.
63 *Enjay Company, Inc.

Steel.....Nickel-clad steel equipment is used not only to resist general corrosion, but also to prevent stress-corrosion cracking. Technical Bul. T-29.
102 *The International Nickel Co.

Electrical & Mechanical

Batteries, Dry.....Design manual, available to engineers engaged in the design of battery-powered equipment, provides data on batteries ranging from 1½ to 510 v.
183A Burgess Battery Co.

Batteries, Stationary.....Bulletin 210 gives reports on engineering studies of the effect of temperature on battery capacity. Also data and general information.
183B Electric Storage Battery

Boring Bar.....A new and more effective device for easier removal of rings formed during nodulizing and similar kiln operations is described in Bulletin 58-B.
183C Kennedy Van Saun Mfg.

Cutters, Knife.....Bulletin App. 216 gives details on designs, sizes and speeds of the 700 series. Main bearings are available in different types. Send for your copy.
183D Taylor, Stiles & Co.

Drive.....New Allispede drive can be supplied with in-line or right-angle integral gears, brake & tachometer. Sizes from 1 to 20HP with speed variations to 8:1. Bul. 3300.
179 *The Louis Allis Co.

Gaskets.....A complete line including "900" for gasketing against steam or gases to 700°F., "7021" for hot oils, and "7228" for solvents. Details in Gasket Folder AD 162.
35 *The Garlock Packing Co.

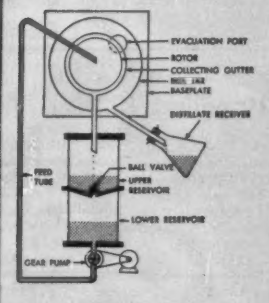
Lift Truck Attachments.....Complete catalog of mechanical and hydraulic lift truck attachments illustrates 26 ways to get more from lift trucks. Send for your copy.
183E Little Giant Products

Mechanical Seal.....Bulletin AD-164 lists types, optional designs, specifications and installations of the new Chemiseal mechanical seal. Bellows design.
183F The Garlock Packing Co.

Motor Development.....A new brochure, "59 ideas for modernization in 59" is available. Includes electrical modernization . . . a better way of getting variable speed, etc.
156 *Allis Chalmers

* From advertisement, this issue

Concerning
vacuum distillation
and a corollary of Charles' Law



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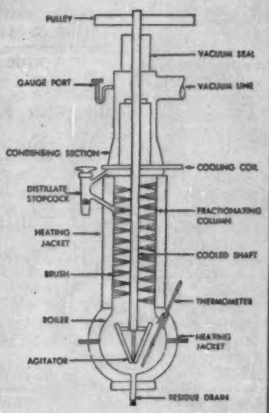

As you lower the pressure above a liquid, you also lower the liquid's boiling point —thus a corollary of Charles' Law.

This corollary is the very essence of high-vacuum distillation of heat-sensitive molecules.

Currently, you can put the corollary to work in your research with either of two types of CEC high-vacuum stills.

1.

CEC Centrifugal Molecular Stills have lower thermal hazard than any other high-vacuum stills now in use. With them you can distill up to MW 1200 easily, swiftly, safely.

You feed distilland to the center of a rapidly revolving concave cone. As the liquid spreads out over the heated surface of the cone, lighter fractions are evaporated into a cooled bell jar, where they condense and pass into a receiver.

Centrifugal force keeps the film moving rapidly so that the liquid is exposed to heat for just a fraction of a second. Since the whole system is under high vacuum, distillation proceeds at relatively low temperatures.

These stills have proved invaluable in work with resins, plasticizers, waxes, fatty acids, sterols, hormones, oils, and perfumes.

2.

CEC Brush Stills are the *most efficient* fractionating stills in the high-vacuum field, producing much finer fractions than centrifugal molecular stills.

Usually you can get the fraction you want in a single pass.

A unique feature of this still is an internally-air-cooled condensing brush. This brush revolves rapidly inside a heated column. It serves as a condensing surface and also sweeps the surface of the column eliminating streaming and channeling.

Distilland evaporating from a boiler at the base of the column condenses on the brush. The brush instantly flings the condensate out to the heated column where re-evaporation takes place.

The process repeats itself up the length of the column moving the more volatile fractions of the distilland toward the top where they are collected as distillates of high purity.

Brush stills are recommended for use with materials of MW 250 to 900. They have been used to distill tall oil, microcrystalline wax, citral, cedarwood oil, polyethylene glycol, peppermint oil, and ionone.

For further information on these stills, write us for bulletins.

Consolidated Electrodynamics

Rochester Division, Rochester 3, N. Y.

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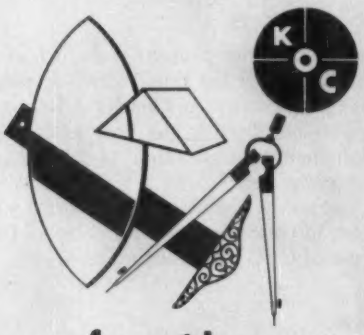

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LITERATURE . . .

Rectifiers, Silicon.....Offer low cost, high efficiency, ease of installation & no costly outages. Complete information on these new air-cooled rectifiers is available.
16-17 *Westinghouse Electric Corp.

Tiering Truck.....Available in capacities of either 2,000 or 3,000 lb., Model Mn narrow-aisle, rider-type electric tiering truck is described in Circular 35K.
184A Lewis-Shepard Products

Tractors, Utility.....A 6-page leaflet shows manufacturer's line of trenching, loading and dozing machines, including selection of specialized attachments.
184B J. I. Case Co.

Turbines, Gas.....Turbine line features high efficiency, versatility and low maintenance. Two new catalogs describe line's latest developments. Send for your copy.
184C Clark Bros. Co.

Handling & Packaging

Box Closures.....Specially prepared for users of fibreboard boxes, new brochure guides the evaluation of methods currently in use to effect economies. Bulletin avail.
184D Acme Steel Co.

Can Line Equipment.....Equipment automatically feeds, weigh-fills, packs and ejects cans of dry granular, crystalline or powdered materials. Bul. 306.
184E B. F. Gump Co.

Conveyor Belts.....The twenty headaches most frequently suffered by conveyor belt users can be relieved through the use of a handy slide card.
184F U. S. Rubber Co.

Conveyor, Overhead.....Catalog CDA describes low-cost, easily installed, quiet-operating overhead conveyor. All components illustrated. Send for your copy.
184G American Monorail Co.

Conveyor, Pneumatic.....Bul. I-28 tells how to select, operate & maintain systems for transporting dry, bulk materials. Positive, negative & combination systems described.
40b *Sprout-Waldron & Co., Inc.

Conveyors, Belt & Gravity.....Included in pocket-size folder are basic specification details on the line of package and bulk handling power belt conveyors.
184H The Oliver Corp.

Cooler & Dryer, Pellet.....The industrial Rotaircool for drying & pneumatic conveying of pellets. Has major redesign features. Complete details in Bulletin 202.
40a *Sprout-Waldron & Co., Inc.

Feeders, Gravimetric.....Simplex or duplex gravimetric feeders for liquids or solids are the subect of Bulletin 32-R2. Capacities from 1 to 60,000 lb./hr.
184I Omega Machine Co.

Feeders, Vibrating.....for handling a variety of materials, densities & sizes. Details on how vibrating equipment & controls can simplify your materials handling in Cat. 930.
36 *The Jeffrey Mfg. Co.

* From advertisement, this issue

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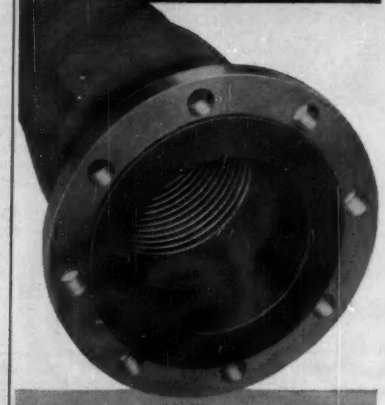
LEAKPROOF
FLEXIBLE



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Stands pressures up to 200 psi . . . rubber covered and leakproofed with special packing. Safe, sure protection for conveying the most volatile of chemicals and liquids without discoloration, contamination or corrosion. Ideal for handling solvents, special chemicals, high octane gasolines and jet fuels.

It is lighter in weight than any comparable competitive hose . . . easy to handle with swivel flange that allows installation in any position without turning entire hose to meet bolt holes. Available in sizes 2" to 12" I.D. Write for full details to Pennsylvania Flexible Metallic Tubing Co., Inc., 7234 Powers Lane, Philadelphia 42, Pa.

NEW BOOK
Gives complete technical details on flexible tubing. Free copy for you.

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FLEXIBLE

LITERATURE . . .

Hydraulic Cylinder.....New high-pressure hydraulic cylinders, rated at 2,000 and 3,000 psi. are available in 13 basic mounting styles and a choice of rod sizes.
185A Hanna Engineering Works

Storage Tanks.....fabricated from 3003 alloy & are available in both horizontal & vertical types in sizes ranging from 5,800 to 21,400 gal. Details in Bulletin AD 387.
185B Aluminum Co. of America

Heating & Cooling

Cooling Towers.....The Class 600 Double-Flow embodies many new & important advancements in water cooling practice & achievement. Complete information available.
8-9 *The Marley Company

Cooling Towers.....Counterflow Cooling Tower Bul. 4.9.080A is available with information on operation, capacity & a wide variety of factors influencing performance.
29 *J. F. Pritchard & Co.

Drum Dryers.....Bulletin 384 explains mechanical details of atmospheric and vacuum dryers equipped with either single or double drums; illustrates typical applications.
185C Buflovak Equipment Div.

Feedwater Heater Closures.....Bulletin 201.1K1 presents information on redesigned high-pressure closures for feedwater heaters and other heat exchangers.
185D American-Standard

Generators, Steam.....features controlled circulation & balanced feed, a principle of using a continuous single pass tube. Produces steam in 3 minutes, from a cold start.
165 *Clayton Mfg. Co.

Heat Exchanger.....Sectional Aero heat exchanger gives close temperature control. Capacity range is 7,000,000 to 18,000,000 Btu./hr. Details in Bul. 132.
B204 *Niagara Blower Co.

Heat Exchanger Tubes.....Aluminum heat exchanger tubes combine initial equipment economies with freedom from chemical attach. Booklet AD 186 for complete details.
185E Aluminum Co. of America

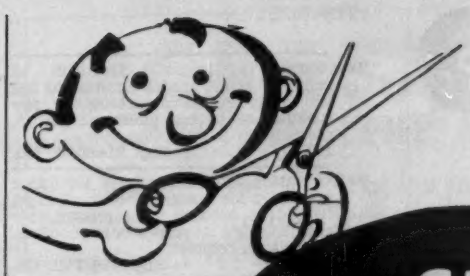
Heaters, Dielectric.....Features include: clean wiring arrangements, bakelite standoff, ceramic coils, sturdy relays. Complete details in Bulletin 15B6431C.
159 *Allis-Chalmers

Insulation, Block.....An amosite asbestos-base block insulation is described in detail in a new brochure. Recommended specifications for vessel insulation.
185F Aber Co.

Kilns.....Any type, for any application such as cement, coke, lime, pigments, nodulizing, sintering, etc. Estimates, constructive suggestions & drawings available.
69 *Vulcan Iron Works

Preheater.....For details on air preheaters and information on potential fuel economy, a factual article is available. Slagging is reduced & cuts boiler downtime.
28 *The Air Preheater Corp.

* From advertisement, this issue



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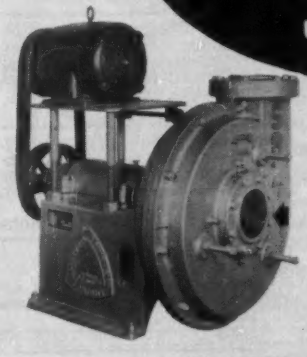

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Light weight, accurately engineered rubber parts boost efficiency up to 3 times, lower pumping costs as much as 50%. Specially-bonded, molded rubber-on-steel impellers and liners last up to 15 times longer. Also available in acid-proof construction. With or without sealing water.

Capacity to 3000 g.p.m.
Write for Bulletin No. P9-B10

DENVER Equipment for the Chemical Process Industries

DENVER Agitator Type Disc Filters
Sizes to 9' dia. x 12 Disc
Write for Bulletin No. F9-B5

DENVER Spiral Rake Thickeners
Sizes to 150' dia.
Write for Bulletin No. T5-B6

DENVER SRL-V Vertical Sump Pumps
Capacity to 1400 g.p.m.
Write for Bulletin No. P9V-B1

DENVER Adjustable Stroke Diaphragm Pumps
1" to 10" Simplex and Duplex, Capacity to 1000 g.p.m.
Write for Bulletin No. P8-B11

DENVER Agitators and Mixers
Sizes to 32' x 32' and Larger
Write for Bulletin No. A2-B4

DENVER Cyclones
Sizes from 3" to 24"
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LITERATURE . . .

Reactors.....Complete facilities to provide heat transfer equipment for the most exacting services in petroleum refineries, chemical plants, etc. Bulletin available.
112 *Henry Vogt Machine Co.

Refrigeration Equipment.....for quick freezing, ice making, cold storage, humidity control, condensing, air conditioning or any process cooling. Details on request.
162 *Frick Co.

Steam Traps.....The TD steam trap can be installed in tight places. Literature Kit "2A" plus latest bulletins on this and other steam traps are offered.
89 *Sarco Company, Inc.

Instruments & Controls

Chemical Feeders Nomograph..... Free nomograph enables engineers to calculate the correct sizes for controlled-volume pumps and holding tanks in a few seconds.
186A Milton Roy Co.

Control, Electronic.....permits remote location of weight recording instruments . . . assures automatic balance detection, automatic zeroing etc. Literature offered.
149 *Fairbanks-Morse & Co.

Control Instrumenation.....Bulletin GEA-6972 provides the latest descriptive information on GE's line of recorders, controllers and indicators.
186B General Electric Co.

Controls, Pressure-Vacuum.....Catalog furnishes descriptive data on over 190 controls, including general purpose, sensitive, absolute and explosion-proof units.
186C United Electric Controls

Flowmeter.....Handbook gives basic engineering data for application, sizing and flow rate calibration prediction of low-flow rotameters. Tables, graphs and equations.
186D Fischer & Porter

Gage, Magnetic.....for liquid level observation. Safety design seals against escaping gases. Available with electric alarms. Engineering sheet is offered.
R190 *Jerguson Gage & Valve Co.

Instruments.....Combined technical skill and complete facilities for highly precise work in optics, mechanics and electronics. Details contained in literature.
TL184 *Kollmorgen Optical Corp.

Instruments.....New Catalog covers all details of Pressure Gauges, Needle Throttling Valves, and Dial Thermometers. All products available with AND threads.
T204 *Marsh Instruments Co.

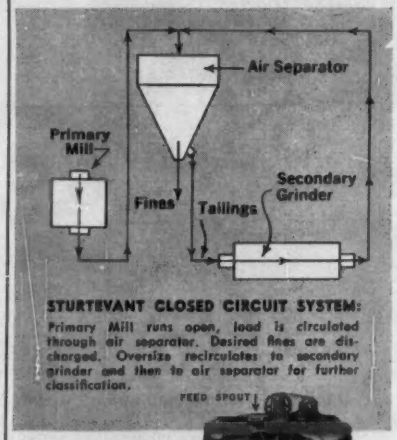
Instruments.....Vector series instruments serve any process. Feature interchange of parts, even among instruments performing entirely different functions.
34a *Republic Flow Meters Co.

Instruments, Optical.....16 p. booklet, RC 178A, contains engineering data on company's electron optical instruments. Photos, micrographs and diagrams.
186E Philips Electronics, Inc.

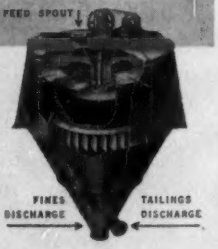
* From advertisement, this issue

STOP OVERWORKING GRINDING MILLS

Boost Production of 40 to 400 Mesh Fines As Much As 300%


Air Separator
Primary Mill
Fines
Tailings
Secondary Grinder
STURTEVANT CLOSED CIRCUIT SYSTEM:
Primary Mill runs open, load is circulated through air separator. Desired fines are discharged. Oversize recirculates to secondary grinder and then to air separator for further classification.

Current users of Sturtevant Air Separators include manufacturers of sulfur, soybeans, phosphate, chocolate, feldspar, sand, pigments, limestone fillers, abrasives, plasters, ceramics and cement.



Sturtevant Air Separators Can Lower Power Costs Up To 50%

Production capacity impossible in single-pass grinding results from using Sturtevant Air Separators in closed-circuit grinding systems. They are of proved advantage in all secondary reduction processes.

Fines pass through grinding mills unhindered, are classified, and the oversize returns for further grinding. Grinding mills are free to perform at top efficiency, their output frequently increased as much as 300% and power costs cut up to 50% (documented by 30 years of Sturtevant air separation experience in the cement industry).

Precise Classification; Circulates Loads of 800 tph

Sturtevant Air Separators circulate production loads of up to 800 tph. Simple adjustments make possible counter-action between air currents and centrifugal force to the point where a product of almost any desired fineness may be collected while coarser sizes are rejected.

A 16 FT. STURTEVANT, for example, took a feed rate of 800 tph, containing only a small percentage of desired fines, and delivered 30 tph 90% 200 mesh, recirculating the oversize through the grinding circuit. (In the cement industry, Sturtevant units deliver up to 60 tph raw cement fines, 40 tph finished cement fines.)

Nine models available, diameters from 3 to 18 ft. For more information, request Bulletin No. 087. (Bulletins also available on Micronizers, Blenders, Crushers, Grinders.) Write STURTEVANT MILL CO., Clayton St., Boston, Mass.

Manometers.....Catalog describes line of manometers and accessory equipment for plant and laboratory manometers. U-type, well-type, inclined-tube type.
187A King Engineering Corp.

Meters.....for hot or cold liquid measurement. Meters measure volumetrically . . . each nutating cycle of the piston displaces a fixed volume. Literature.
174 *Buffalo Meter Co.

Pipeline Viscometer.....Bulletin No. V1223 describes a pipeline viscometer for temperature, pressure-vacuum, and explosion-proof applications. Range: 0.1-1,000,000 cp.
187B Norcross Corp.

Recording Turbidmeter.....Turbidmeter continously monitors cloudiness of process fluids. Bulletin gives applications, principles of operation and specifications.
187C General Electric Co.

Speed Control Systems.....Completely revised brochure covers the operation and application of speed drive and pneumatic control systems. Send for your copy.
187D U. S. Electrical Motors

Steam Meter.....Model SMDH Shuntflow steam meter has been simplified for more efficient replacement of orifice plates to change capacity. Bulletin 400-P25.
187E Builders-Providence

Thermometers.....Weather-proof Bi-Metal thermometers offer mounting styles, dial sizes, temperature ranges & stem lengths.
84 *Manning, Maxwell & Moore, Inc.

Thermometers.....Bimetal thermometers feature a dampening bearing above the bimetal element that makes them extra resistant to shock & vibration.
99a *Rochester Mfg Co.

Transmitter.....The M/44 indicating temperature transmitter for fast, sensitive response under roughest field conditions. Uses any filled thermal system. Bul. 13-28A.
37 *The Foxboro Co.

Pipe, Fittings, Valves

Fittings.....A new 86-page master reference catalog on stainless steel pipe fittings gives detailed information on manufacturer's line. Tables, corrosion data, etc.
187F Ladish Co.

Hose, Flexible.....General Catalog shows full line of standard flexible hose & tubing products. American is equipped to work in copper alloys, stainless steel, etc.
93 *The American Brass Co.

Hoses.....Made of thick, resilient rubber, which is designed to absorb pump vibration traveling along pipelines.
208 B. F. Goodrich Industrial Products

Joints, Expansion.....Offer lateral or angular motion without flow reduction of conical type liners. New 28-page Expansion Joint Design Guide is available.
177 *Flexonics Corp.

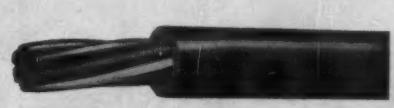
* From advertisement, this issue

CRESCENT
POLYETHYLENE MULTITUBE

Special Types of Cabled Instrument Tubing to meet your specific need

These types employ HIGH MODULUS, high density polyethylene tubes made from new low pressure process polyethylene. Four to nineteen tubes of ¼" OD are SPIRALLY CABLED together under heavy protective coverings which are designed to meet the unusually severe installation requirements with lowest cost.

TYPE XPT-U
Underground and General Purpose Type
Designed for direct earth burial or use in underground conduit and for above ground where subject to moderate mechanical abuse. Tubing is protected by a thick, tough polyvinyl chloride (PVC) sheath resistant to impact, corrosion and flame.



TYPE XPT-F
Flash Fire Resistant Type
A thick PVC sheath, heavy asbestos braid and overall PVC sheath over the tubing assembly provides several minutes of time delay for shutdown in the event of a flash fire. This construction also gives adequate protection from welding and cutting metal splash.

TYPE XPT-FA
Flash Fire Resistant - Armored Type
For complete mechanical protection, the tubing, thick PVC sheath and heavy asbestos braid are covered by an interlocked, galvanized steel armor. Designed for dry locations, type XPT-FA also gives several minutes of time delay in the event of a flash fire.

Send for BULLETIN No. 458-H with complete information.

CRESCENT INSULATED WIRE & CABLE Co.
TRENTON, N. J.

where there's a
drying operation
leading manufacturers* insist
on DUSTEX COLLECTORS

DUSTEX miniature cyclone tubes, cast of white iron, provide an ultra-hard, cling-free, self-cleaning surface to assure maximum material recovery at a constant, high-speed rate.

DUSTEX patented design prevents condensation within the collector when inlet temperature is above the dew point. Handles temperatures up to 800°F. There are no filters to clog, no sludge to pump. It's virtually maintenance free!

LOW INSTALLATION COST and up to 99.8% efficiency make DUSTEX the perfect collector for spray dryer, rotary dryer or flash dryer processes.

**Name on request*

Write today for this free bulletin on the new D-584 DUST COLLECTOR.

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LITERATURE . . .

Nozzles.....Catalog gives complete details on lightweight, precision built steel spray nozzles. There is a Spraco model for every problem & application.
166 *Spray Engineering Co.

Packings, Solvent.....after testing on caustic pumps, found to outlast any packing. Technicians work with engineers of chemical companies to develop the best.
153 *U. S. Rubber

Pipe.....Bulletin TS-1A gives complete details on fluoroflex-T pipe. It resists corrosion, and can handle hydrofluoric acid with complete safety & no maintenance problems.
14 *Resistoflex Corp.

Pipe Fittings.....A new 86 pg. stainless steel fittings catalog & technical manual gives detailed specifications, dimensions & ordering information on complete line.
33 *Ladish Co.

Pipe, Non-Metallic.....Bulletin gives complete engineering data and general information on a series of Fibercast chemical and line pipe, tubing and fittings.
188A Fibercast Co.

Piping.....Booklet AD 197 for complete details on aluminum pipe and fittings. It resists attack from the materials it carries as well as corrosive atmospheres.
188B Aluminum Co. of America

Seals, Clipper.....Types for all applications such as continuous high speed operations, for small shaft diameters, for small clearences, etc. Book PK-71A for data.
42 *Johns-Manville

Tubing, Flexible.....for any operating conditions, bronze, galvanized & stainless steel corrugated & interlocking tubing. All types, all sizes.
R184 *Pennsylvania Flexible Tubing Co.

Tubing & Pipe.....These super-stainless & high alloy grades meet a broad range of tubing & pipe requirements. Properties & recommended uses in Bul. T. D. 125.
30 *The Carpenter Steel Co.

Tubing, Polyethylene.....Special types of cabled instrument tubing to meet specific needs. All types are outlined in bulletin 458-H.
T187 *Crescent Insulated Wire & Cable Co.

Tubular Products.....New catalog contains information on types, grades, lengths, finishes and general characteristics of stainless steel and alloy tubing.
188C J. Bishop & Co.

Unions, Steel.....New catalog gives all the vital facts . . . details of construction . . . every specification from metal to hardness of hardness of seats to exact dimensions.
168 *Clayton Mark & Co.

Valves, Ball.....will provide leakproof sealing in long, troublefree service. Features quarter-turn opening & closing. For information see Catalog 1000.
85 *W-K-M, ACF Division

Valves, Diaphragm.....Packless valves are made in a wide variety of body materials, including choice of diaphragm, disc insert & optional body lining.
77 *Crane Co.

* From advertisement, this issue

CONE ROOF

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STEEL PLATE
STAINLESS STEEL
STAINLESS CLAD PLATES
T-1 STEEL AND OTHER STEEL ALLOYS
NICKEL-CLAD
ALUMINUM
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HAMMOND TANKS

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FIELD ERECTED TANKS AND VESSELS FOR LIQUIDS, GASSES VAPORS AND STORAGE OF DRY MATERIALS

FIRE PROTECTION AND WATER SUPPLY

ELEVATED TANKS

HAMMOND IRON WORKS
WARREN, BRISTOL and PITTSBURGH, PA.
PROVO, UTAH • CASPER, WYO.
BIRMINGHAM, ALA.

Sales offices throughout the U.S.A.

Valves, Gate.....Aluminum alloy valves are now available in ½" through 24" sizes. Feature fully revolving double disc, parallel seat principle. Details offered.
44 *Darling Valve & Mfg. Co.

Valves, Iron.....features include: corrosion, heat & shock resistance, strength, proven design, & low cost. The new circular on ductile iron valves is available.
98 *Walworth

Valves, Stainless Steel.....Aloyco valves offer staying power, minimum maintenance & corrosive service. Other types, alloys, sizes & pressures available.
90 *Alloy Steel Products Co.

Process Equipment

Agitators.....Model T features interchangeable ratios from 6.23:1 to 100:1. Model WT units offer ratios from 3.5:1 to 68:1.
160 *New England Tank & Tower Co.

Blenders.....Twin-Shell liquid-solids blender easily & thoroughly disperses as little as 0.5% by weight of any liquid into dry solids. A type for every process.
50-51 *Patterson-Kelley Co.

Cabinet Cloth Filter Collector..... Model 81 requires only 28" x 28" floor space & provides cloth filtering area of 150 sq. ft. Complete details available.
189A Torit Mfg. Co.

Centrifugals.....Reineveld automatic centrifuges used for dewatering & washing of crystalline solids & for separation & clarification of fine amorphous slurries. Bul. 356.
T195 *Heyl & Patterson, Inc.

Centrifugals.....Booklet No. 2648 illustrates & describes automatic dischargers, liquid vapor seal, load measuring device, etc.
176 *The Western States Machine Co.

Demineralizer, Water.....Model TM-6, two-bed demineralizer at flow rate of 2500 G.P.H. Available in mixed-bed, single, two, & four-bed models.
97a *Barnstead Still & Sterilizer Co.

Dryers, Rotating Vacuum.....is available in six sizes and include provisions for steam or hot water heating. Complete information & application data available.
61 *F. J. Stokes Corp.

Dust Collector.....New 12-page bulletin details the Microdyne dust collector, a wet inertial type that is installed as part of ductwork. Performance curves.
189B Joy Mfg. Co.

Dust Collectors.....Type W Roto-Clone, type N Roto-Clone & Amerjet units offer high collection efficiency for the chemical industry. Bulletins give complete details.
10-11 *American Air Filter Co.

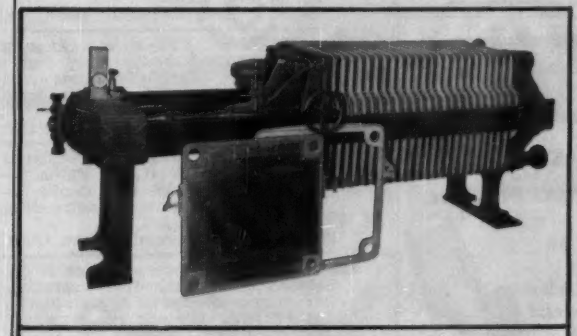
Dust Collectors.....Cyclones feature large-diameter design that eliminates bridging & clogging. Booklet, "The Exclusive Buell Cyclone" for complete information.
178 *Buell Enineering Co.

* From advertisement, this issue

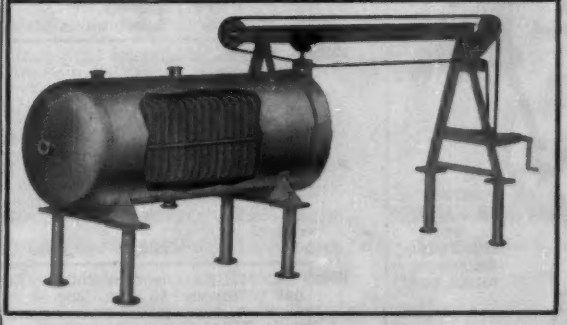
From earliest antiquity man has contrived to solve his problems in solids-liquid separation in a thousand different ways, some quite ingenious.

Today's filtration problems are more challenging than ever, calling for more critical appraisals and precise answers.

At Shriver's we are dedicated to investigating your problems and recommending and building the kind of filter that will *best* meet your specific purpose. And we do build many types! May we be of service?



Shriver filter press with plates of molded wood or glass fiber reinforced polyester and frames of polyvinyl chloride coated aluminum; a new combination of strong, lightweight materials of construction for resistance to many acid and alkaline process materials.



Shriver horizontal tank, vertical leaf pressure filter, with many improved features, recommended primarily for products in which liquid and solids are not miscible with water, or for other cases where the solids must be removed as a semi-dry cake.

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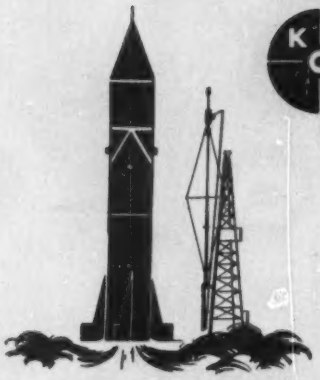

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1 *The Ducon Company, Inc.

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190A Torit Mfg. Co.

Dust Collectors.....Miniature cyclone tubes, cast of white iron, provide ultra-hard, cling-free, self-cleaning surface for maximum material recovery. Bul. D-584.
B187 *Dustex Corp.

Dust Controls.....An efficient dust collecting system, scientifically planned, designed & constructed. Cloth filters bag collectors offer maximum efficiency. Bul. 922.
53 *Pangborn Corp.

Filter.....A completely new series of laminated fiber disc filters designed for hydraulic & other high pressure applications. Complete information on 1555CP filters.
170 *Wm. W. Nugent & Co.

Filter Fabric.....Booklet, "Filter Fabric Facts" answers problems related to fabrics in filtration, rubberizing, coating, laminating, etc. Send for your copy.
207 *Wellington Sears Co.

Filter Fabrics.....all types of wet or dry filtration equipment. Technical assistance in selecting proper fiber & fabric construction for requirements. Bul. KSF-1.
190B Komline Sanderson Corp.

Filter Media.....Filters & separators operate within temperature range from 420 to 1200 F. Pressures from a nearly perfect vacuum to 6,000 psi. Brochures offered.
108 *Purolator Products, Inc.

Filters.....A new catalog is offered with complete details on Fulflo filters. They provide true depth filtration at minimum pressure drop for liquid chemicals, etc.
78 *Commercial Filters Corp.

Filters.....FEinc precoat filter is designed for trouble-free operation, dryer cake discharge & high clarity of effluent. Specific recommendations for your problems.
39 *American Machine & Metals

Filters, Water.....Where high quality process water is needed, diatomite filters provide an effluent second only to distilled water. Bul. 65I & Bul. 909 give details.
67 *R. P. Adams Co., Inc.

Feeding Systems.....Bulletin 32-R2 describes continuous loss-in-weight feeding systems for liquids and dry materials. Offers better quality control.
163 *Omega Machine Co.

Kilns.....If you need a rotary kiln that is unusual in size, type or application, contact the "kiln specialists". Write for estimates, suggestion and drawings.
97 *Vulcan Iron Works

Mills.....Hy-R-Speed Mills for dispersing paints, chemicals, inks, plastics or food products. A new bulletin gives complete details for all requirements.
167 *The J. H. Day Co.

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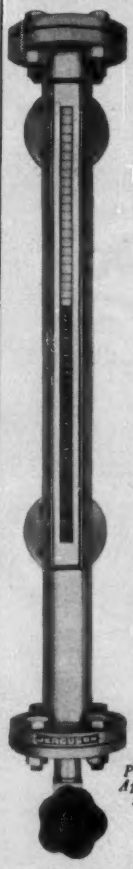

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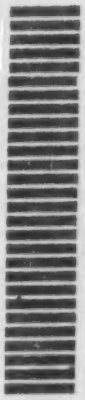

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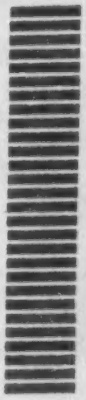

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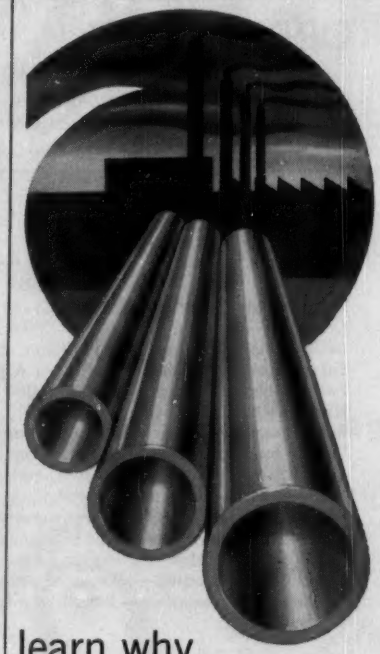

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LITERATURE . . .

Compressors, Axial.....New adjustable stator blade axial compressors get wide capacity range at high efficiency. Small size cuts space requirements. Details offered.
103 *Allis-Chalmers

Compressor, Isotherm.....for large volumes of oil-free air (5,000 SCFM & up, 10-300 PSIA) this type compressor assures the lowest possible kW input. Information.
95 *Brown Boveri Corp.

Fan, Industrial.....Type AH for air handling, type MH for material handling & type LS for long shavings. Offers optional constructions & optional accessories.
82a *American Standard

Fans Axial-Flow.....Provide high air displacement and pressure for cooling, heating and ventilating applications. New 4-page catalog available.
195A Pesco Products

Pump, Corrosion-resistant.....The new 200-D.O. positive displacement pumps has a maximum capacity of 300 G.P.M. Only 17" high. Details contained in bulletin.
155 *Waukesha Foundry Co.

Pumps, Sump.....Revised Bulletin 4500-B presents construction details of the company's line of sump pumps. Ordering data, installation data and optional equipment.
195B Deming Co.

Pump, Transfer.....High-speed, air-powered pump handles pressure gun grease, alcohol, cutting oils, etc. A catalog of industrial lubrication equipment is offered.
45 *Stewart-Warner Corp.

Pump, Turbine.....features water lubrication, two piece head shaft, & special bearings, bearing retainers & pump bowls designed for long life. Illustrated Bul. 6957-1.
80 *Fairbanks-Morse & Co.

Pumps.....Newly designed models are available to handle a wide variety of tough, corrosive & viscous materials. Information on controlled capacity pumps is available.
87 *American Meter Co.

Pumps.....SRL pumps light weight, accurately engineered rubber parts boost efficiency. They handle capacity to 3000 g.p.m. Complete details in Bulletin P9-B10.
185a *Denver Equipment Co.

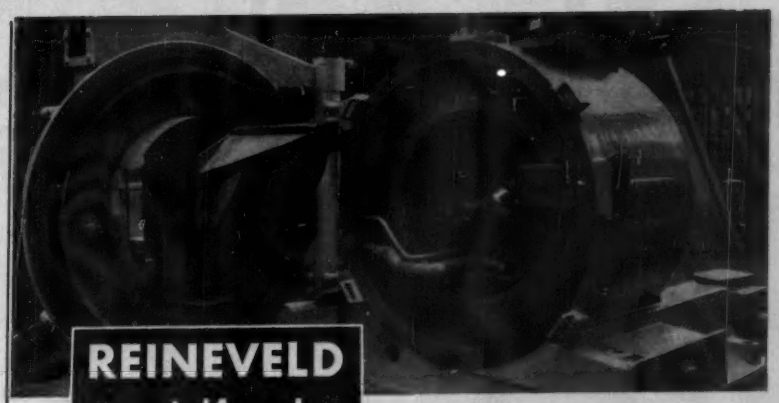
Pumps.....Whatever your pumping needs, vertical pumps for molten chemicals, horizontal pumps for black liquor, caustic, etc. Write for bulletins V-837 & C-355.
R182 *Taber Pump Co.

Pumps.....The type GB single stage, end suction centrifugal pumps handle all kinds of jobs. Bulletins on the complete pump line are available.
172 *Weinman Pump Mfg. Co.

Pumps.....The SESC line offers 120 different sizes with open or closed impellers with capacities up to 2700 GPM & heads to 550 ft. Details in Bul. W-300-B48.
22-23 *Worthington Corp.

Pumps, Centrifugal.....Catalog and performance curves detail a full line of pumps specifically designed to handle corrosive & abrasive fluids in the 1 to 80 GPM range.
B195 *Bart Manufacturing Corp.

* From advertisement, this issue



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Reineveld 51" Automatic Centrifuge showing easy access to internal parts.

are used extensively for dewatering and washing of crystalline solids, and for separation and clarification of fine amorphous slurries. Effective bowl capacities range from 3 to 325 gallons. Reineveld is one of the world's largest builders of centrifugal equipment—avail yourself of the services and experience of a leader.

Consult our listing in CEC or write for bulletin 356.

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now! greater ***safety*** *and efficiency in*

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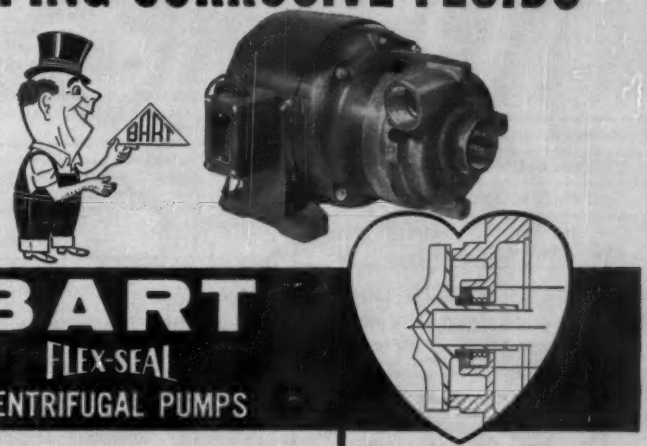

BART

FLEX-SEAL

CENTRIFUGAL PUMPS

At last—a full line of pumps *specifically designed* to handle corrosive and abrasive fluids in the 1 to 80 GPM range, at heads to 70 feet.

No longer need you cut down bigger pumps in range and lose efficiency—or put up with undependable smaller pumps.

Bart pumps have fewer parts to wear or get out of order. Twelve models, each in two materials . . . Type 20 Stainless Steel or Hastelloy C . . . cover almost every application.

Write for catalog and performance curves.

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Effectively minimizes a long-prevalent basic weakness of centrifugal pump design. Self-adjusting to wear. Needs no external lubrication. Carbon stator with ceramic seat, unexcelled for long wear—or zircon filled Teflon stator with Stellite or Worthite seat for severest corrosive service.

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. . . and 33 other platinum group metal chemicals.

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Chemical Division
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PLATINUM WORKS
MALVERN, PA.

LITERATURE . . .

Pumps, Centrifugal.....Catalog contains engineering data, performance charts, diagrams & helpful general information on six standard models. Bulletin 110F.
209 *Eastern Industries Inc.

Pumps, Chemical.....A line of over 78 models, sizes & frames, plus thousands of combinations. An 8-pg. booklet discusses effects of radial loads.
92 *Food Mach. & Chem. Corp.

Pumps, Rotary.....Standard & heavy duty models cover capacities from ⅔ to 1050 GPM, pressures up to 200 PSI. Models available in many types of construction. Cat. K.
205 *Viking Pump Co.

Traps, Steam.....The 44-page, "Steam Trap Book" covers the excellent air handling characteristics & other features. Gives details on selection & installation.
79 *Armstrong Machine Works

Services, Processes, Misc.

Fire Control.....devices put the projectile on target & keep it there. They combine optical, mechanical & electronic skills. Literature is available.
TL182 *Kollmorgen Optical Corp.

Fire Protection Systems.....new 44-page manual gives you a comprehensive picture of advanced methods for Special Hazard fire protection.
88 *Grinnell Co.

Fume Hoods.....2 p. bulletin described closed type fume hoods with Alberene stone topes in Steelab standard sectional furniture line. Accessories listed.
196A Arthur S. La Pine & Co.

Laboratory Sinks.....8 p. bulletin PF/5 describes new sinks just added to company's line of corrosion resistant equipment. Specifications. method of installation.
196B Duriron Co.

Refractories.....Two new booklets about the applications & properties of Carborundum's unique, new super refractories are now available.
171 *Carborundum Co.

Structures.....Design, engineering, fabrication & erection of steel plate structures. Bulletins on: Special Plate Structures & Field Services are available.
81 *Chicago Bridge & Iron Co.

Systems, Density Measuring.....Bulletine NI-158 gives complete details on AccuRay Continuous Flow Density Systems. Designed to meet requirements of the industry.
27 *Industrial Nucleonics Corp.

Titrating Equipment.....8 p. data sheet, pH-83-MI, show how to perform nonaqueous titrations with Zeromatic pH meter and new combination electrode.
196C Beckman

Waste Disposal Units.....are custom designed to your specification. Any size or capacity for use in reducing liquid & semi-liquid wastes or obnoxious gases.
B180 *John Zink Co.

* From advertisement, this issue

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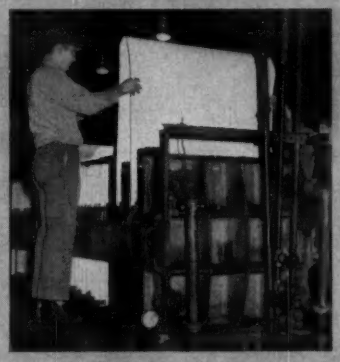
. . . a proven new class of FILTER MEDIA!



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Economical Windsor Felts eliminate the use of secondary dressing materials in many filtering applications!

They're fabricated from selected synthetic fibers to meet your individual specifications . . . and feature a *unique*, engineered construction with precision controlled pore size which provides the following significant advantages:

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- Positive gasketing — minimum leakage
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Windsor Felts are *now* in use on all types of filtration equipment . . . inquire how they can improve *your* operations, write for Data Sheet #18, on company letterhead, please.

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General Offices and Engineering And Research Laboratories 317 Glenville Road, Glenville, Conn.

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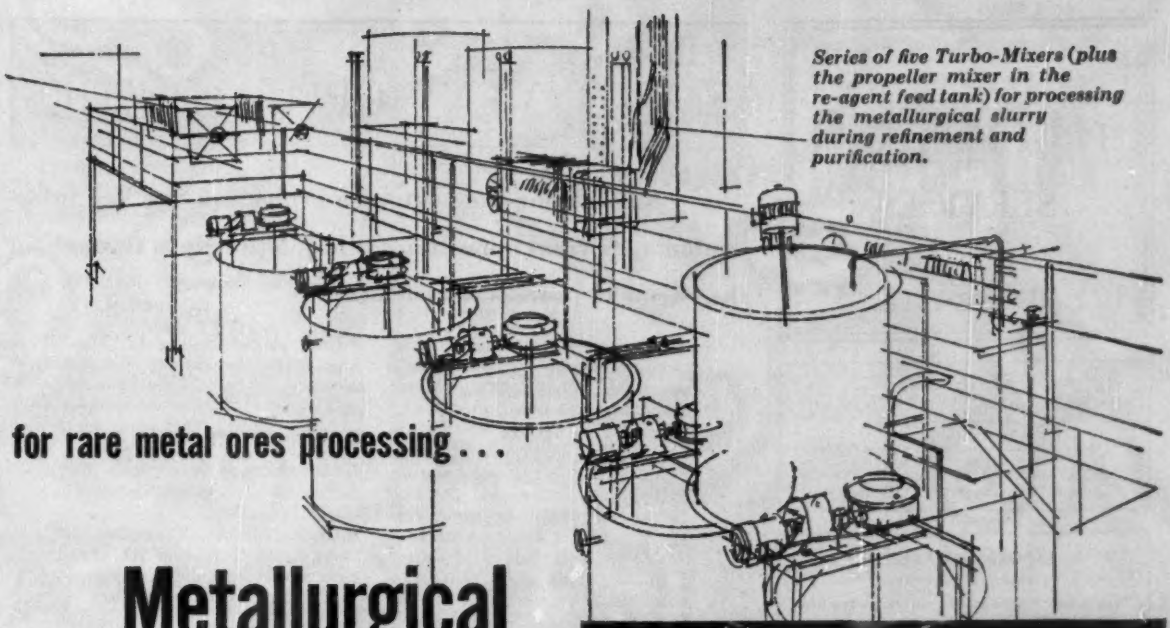
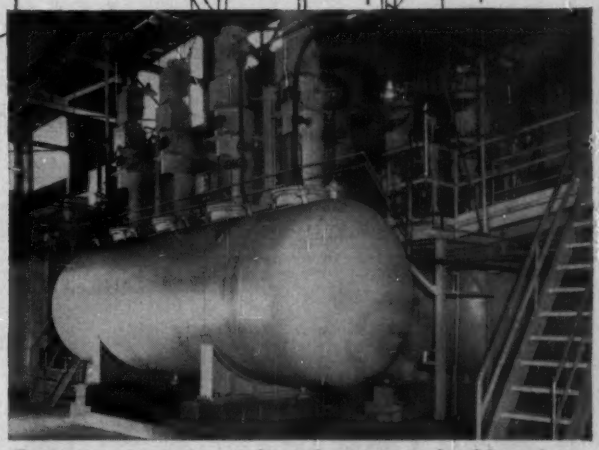


Series of five Turbo-Mixers (plus the propeller mixer in the re-agent feed tank) for processing the metallurgical slurry during refinement and purification.

for rare metal ores processing . . .

Metallurgical Resources chooses TURBO-MIXERS



Four-compartment autoclaves for pressure leaching of ore. Each mixer consists of a mixing and aeration assembly to accomplish the contacting of the liquid-solid-gaseous phase system.

There is no easy way to extract rare metals from their ores. Processing plants, such as that of Metallurgical Resources, Inc. of Newburgh, New York, call for skillful design and dependable processing equipment. To help put this new plant "on stream", Turbo-Mixer custom made all of the equipment required.

Turbo's 45 years of experience in design . . . Turbo's record of dependability . . . and Turbo's single-source responsibility make the difference. If you are in the process of selecting or specifying mixing equipment, call on Turbo. You'll find . . . *it pays to plan with General American.*

FOR DETAILED INFORMATION AND USEFUL DESIGN DATA, SEND FOR THE FOLLOWING BULLETINS:

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Agents required for Laboratory Hydrocyclone Test Set (Chemical Engineering 11/56). RW-8622. Chemical Engineering.

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PRESSES—REACTORS—TANKS

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October 20 Issue
November 17 Issue

PERRY EQUIPMENT CORPORATION

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3 Merco Centrifuges, Mod. B-16
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1 Quonset Hut, 24' x 72'
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S. S. Reactor 1200 gal. 200 lb. pressure.
Stokes 3-DDS2, 1-T, 1-RD3, 2-B
Baker Perkins 100 gal. S.S. double arm, 50 HP jacketed, vacuum, hyd tilt.
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Vulcanizer 60 in. x 9 ft. 125 lbs.
Oliver S.S. Pressure Filter.
Sweetland #2 all Stainless.
Stainless Steel Ball Mill.
Aluminum Condenser 330 sq. ft.
1—Aluminum evaporator, Calandria type, never used, 1300 sq. ft. tube area.
1—Baker Perkins 100 gal. double arm steel.
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Continuous stripping column 2 x 13 steel.

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Liquidations; appraisals our specialty.
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ME MACHINERY AND EQUIPMENT CO.
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$4,500,000 LIQUIDATION
TITANIUM DIOXIDE PLANT
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FILTERS: 1—Eimco 10'x12' rubber covered Rotary Vacuum; 2—Oliver 8'x8' Precoat rubber covered Rotary Vacuum; 1—Oliver 3'x4' lead Rotary Vacuum; 4—Sperry 36" rubber covered Plate & Frame, 30 chambers; 4—Sperry 36" PVC sprayed, 30 chambers; 4—Sperry 42" aluminum, 36 chambers.

EVAPORATORS AND CRYSTALLIZERS: 2—Swenson 300 sq. ft. lead Evaporators, Everdur tubes; 5—Struthers-Wells 8'6" dia. x 24' high rubber lined Vacuum Crystallizers.

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ROTARY DRYERS: 1—Traylor 5'x50'; 1—5'x24'; 1—4'x30'; 1—4'x25'; 1—4'x20'; 1—Proctor & Schwartz 8' wide x 60' long Conveyor Dryer, S.S. belt.

RUBBER LINED TANKS: 1—14'x30' Scrubber Tank; 4—12'x10' agitated; 4—10'x10' agitated; 1—10'x8' agitated; 1—10'x18'; 2—9'x9'; 1—8'6"x24'; 1—6'x7'; 1—9'x10' agitated; 1—8'x35' Scrubber Tank; 1—8'x24' Scrubber Tank; 6—8'x8' agitated; 1—6'x8' agitated; 2—5'x6' agitated; 1—4'x6' agitated.

LEAD LINED TANKS: 2—12'x114' agitated; 2—10'x8'; 1—8'x12'; 1—8'x10' agitated; 2—8'x7' agitated; 1—6'x8'; 1—6'x7½'; 1—5'x4' agitated; 1—4'x4'.

STEEL TANKS: 1—24'x15'; 3—20'x20'; 1—13'x12'; 1—11'x20'; 1—10'x10'; 1—10'x9' agitated; 4—8'x30' pressure; 2—8'x12'; 1—8'x8' agitated; 1—8'x8'; 1—8'x6'.

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Partial List of Values **Circular Being Prepared**

Representative On Premises For Inspection

Baltimore Telephone: Medford 3-2911

BRILL EQUIPMENT COMPANY
2401 THIRD AVE., NEW YORK 51, N. Y.
Tel. CYpress 2-5703

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DONORA ZINC WORKS — DONORA, PA.

1—Traylor 10' x 120' Rotary Kiln, ¾" shell.
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2—Herreshoff 20' dia., 16 hearth, Furnaces.
1—Buflovak 550 sq. ft. Monel Single Effect Evaporator.
2—Swenson 6'6" dia. x 5' deep, steel, jacketed Vacuum Pans.
1—Blaw-Knox 1400 gal. steel, jacketed, agitated Vacuum Kettle.
1—10,000 gal. Horizontal Steel Pressure Tank, 200# pressure.
10—Lead lined, agitated Tanks, 1000 to 6500 gallons.
Troughing Belt Conveyors; Bucket Elevators; Bins, 50 to 500 tons; Ball Mills; Jaw Crushers; Roll Crushers; Air Compressors.

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1—Blaw-Knox 500 gal. 304 clad, jacketed, agitated Reactor.
2—Pfaudler 1500 gal. glass lined, jacketed, agitated Reactors, 90# jacket.
1—750 gal. nickel clad Mixing Tank, 125# internal, with nickel coils.
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1—Vulcan Briquetting Press, 30" dia. x 12½" face, 304 S.S. rolls, 50 HP.
1—3500 gal., 304 S.S. jacketed, agitated Tank, 9' x 7'.
1—Haveg 4000 gal. closed Storage Tank.
2—5000 gal. 304 S.S. Horizontal Tanks, 6'6" x 20'. Unused.
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1—Sharples C20 Super-D-Hydrator, 316 S.S., vapor tight XP Timers.
2—Sharples PN14 & PY14 Super-D-Canters, 316 S.S.
1—Sharples CH2 Nozzlejector, 15 HP.
4—Bird 18" x 28", 24" x 38", 316 S.S. continuous Centrifuges.
3—American 42" x 120" Double Drum Dryers, 10 HP motors.
1—Buflovak 48" x 40" nickel, single drum Flaker.
1—Bird 40" suspended Centrifugal, 347 S.S. perforated basket.
2—Buflovak 250 & 20 sq. ft., 304 S.S. forced circulation Evaporators.
2—Feinc 5' x 6' stainless steel Rotary Vacuum Filters.
2—Sparkler 33-S-28 Pressure Filters, 150 sq. ft., 304 S.S.
1—Niagara 36 H-110 horizontal 304 S.S. Filter, 110 sq. ft.
1—Baker Perkins #16 TRM, 150 gal., jacketed sigma blades, Vacuum Mixer.
1—Baker Perkins #15 VUMM, 100 gal, jacketed Mixer, 100 HP motor.
3—Stokes R, single punch Tablet Machines, Unused.

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7' x 120' Rotary Kilns
8' x 125' Rotary Kiln
8'8" x 70' Ruggles-Cole Rotary Dryer
9' x 125' Rotary Kiln
604-24 Stainless Rete-Louvre Dryer
705-24 & 502-16 Rete-Louvre Dryers
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5' x 40' Rotary Kiln with 2' cooler
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3—Tolhurst center slung centrifuges, 40" and 48" with rubber covered perforated basket
1—Baker Perkins type 316 SS Ter Meer Centrifuge, Model HS-24"
1—Sharples #16 P pressurite SS super centrifuge

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4—Link Belt steel roto louver dryers, Model 207-10, 310-16, 310-20, 604-20
1—Buflovak double drum dryer, 42" x 120"
1—Stokes Model 59DS steel rotary vacuum dryer, 5' x 30'
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2—Patterson Kelley, steel heat exchangers, 1000 sq. ft. each
2—Badger type 316 SS heat exchangers, 400 and 480 sq. ft.
2—Belle & Grossett Heat exchangers, steel, 73 sq. ft. each
6—Struthers Wells heat exchangers, 885 sq. ft.
1—Patterson Kelley steel heat exchanger, 427 sq. ft.
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2—Stokes tablet presses, Model T
1—Bolling 8" x 16" 3 roll laboratory calender
1—Swenson type 316 SS vacuum crystallizer, 3'6" x 12'
1—Swenson type 316 SS vacuum crystallizer, 2'6" x 12'

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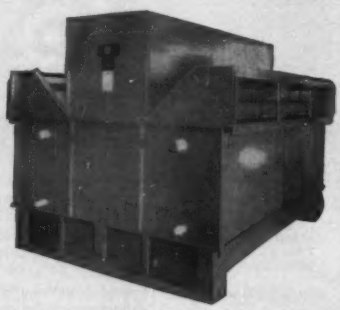

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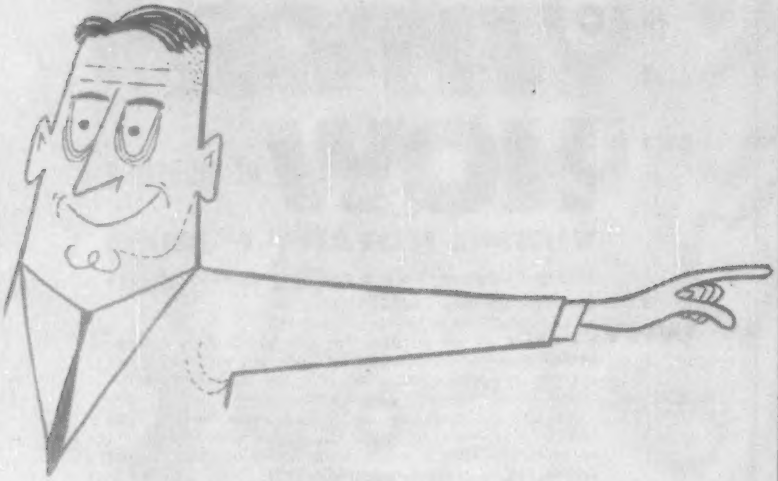

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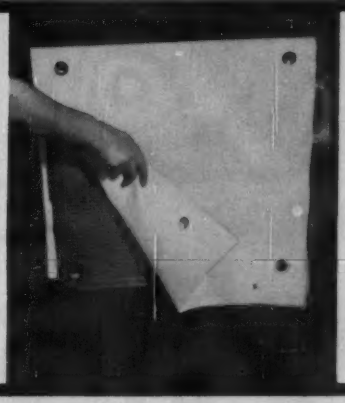
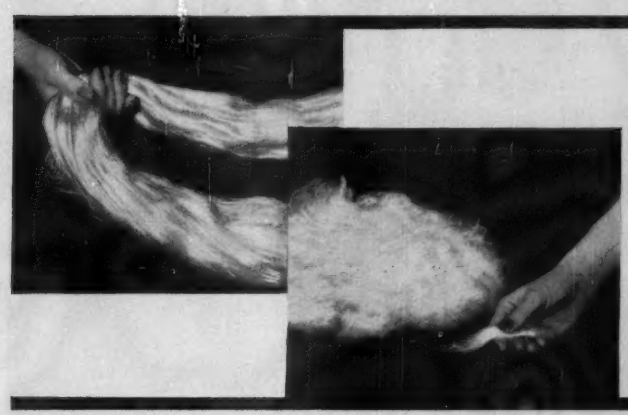
FILTER FABRIC QUIZ

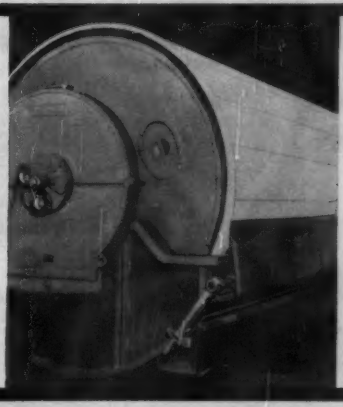
1. Where cloth must be pierced to accommodate the fittings on certain filter presses, care must be taken that the cloth will still fit the fixture, after use. In this regard, pre-shrinking is to cotton fabrics what_____ _____is to synthetic cloths.





2. True or false: characteristics of synthetic fabrics are practically the same whether they are made from staple or filament fibers.

3. True or false: vacuum drum filters can generally use lighter weight fabrics than pressure filters.



Knowing where to get the information and help you need, when you need it, is lots easier than trying to be both a processing engineer *and* a textile technician. Wellington Sears people and the filter specialists who distribute our fabrics are always ready to help with your filter cloth problems. Call us, and for some more handy information, write Dept. L-11 for our "Filter Fabric Facts."

Turn page upside down for answers:

1. heat-setting
2. false
3. true

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B.F.Goodrich

Photo courtesy Jones & Laughlin Steel Corporation, Pittsburgh, Penna.

Good riddance to bad rubbish —through hose

B. F. Goodrich improvements in rubber brought extra savings

Problem: At this power plant they have to get rid of huge loads of a waste material, called fly ash, every day. It's collected from furnaces, washed, then piped down the side of that building and away to a disposal pit so as not to polute the air or a near-by river. Fine, except that this mixture of gritty fly ash, corrosive acid water, sharp slivers of metal was eating holes through the metal pipe in only six months. Each pipe replacement cost $700 plus about 100 hours of workers' time.

What was done: Company engineers, working with a B.F.Goodrich distributor, decided to replace the pipe with rubber hose specially developed by B.F.Goodrich to handle rough materials. The lining of this hose is made with the toughest, wear-resisting rubber known. The hose is so rugged that it's even used in some places to handle broken glass, chunks of coal, granite chips.

Savings: The B.F.Goodrich hose had been on the job 8 years when the picture was taken. It gulps thousands of gallons of acid water and grit every day, but shows no sign of wear, looks good for many years more.

By lasting 7½ years longer than pipe, plant engineers figure that the B.F.Goodrich hose has already saved $6400 in replacement costs and $4800 worth of maintenance time.

Where to buy: Your B.F.Goodrich distributor has exact specifications for the B.F.Goodrich hose described here. And, as a factory-trained specialist in rubber products, he can answer your questions about *all* the rubber products B.F.Goodrich makes for industry. *B.F.Goodrich Industrial Products Company, Dept. M-463, Akron 18, Ohio.*

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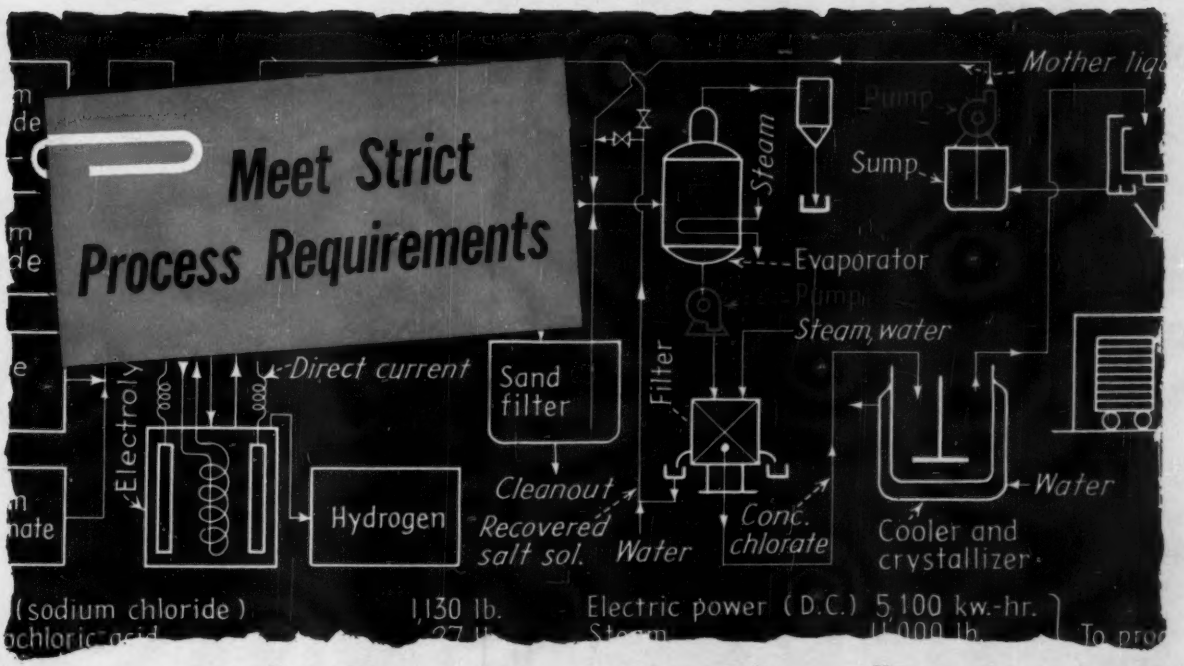
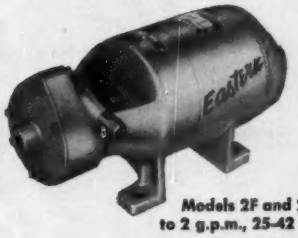
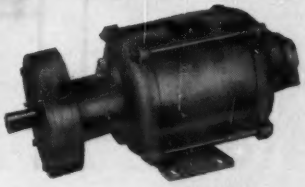


. . . with Eastern Centrifugal Pumps



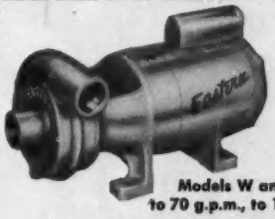
Models 2F and 2J
to 2 g.p.m., 25-42 p.s.i.



Model D-11
to 7.5 g.p.m., to 18 p.s.i.

Model F
to 17 g.p.m., to 17 p.s.i.

Models U-17 and U-34
to 38 g.p.m., to 21 p.s.i.



Models W and Z
to 70 g.p.m., to 11 p.s.i.

Models 3F and 3J
to 5 g.p.m., 29-65 p.s.i.

Recent redesign of these close-coupled Centrifugal Pumps has gained tremendous ruggedness and allowed for a wide selection of power requirements. In every detail of size, weight, space requirements, power, and costs, Eastern pumps fill the bill for strict process standards.

Six standard models range from 1/8th to 3/4 H.P., with capacities up to 70 G.P.M., pressures to 65 P.S.I. Eastern Centrifugal Pumps are available in Cast Iron, Bronze, Stainless Steel, Monel, and Hastelloy "C".

Eastern's engineering service offers many special models to meet your specific needs as to capacity and construction. Recommendations entail no obligation, and your inquiries are invited.

NEW EASTERN CATALOG

Eastern Centrifugal Pump Catalog contains engineering data, performance charts, diagrams and helpful general information. Request Bulletin 110F.

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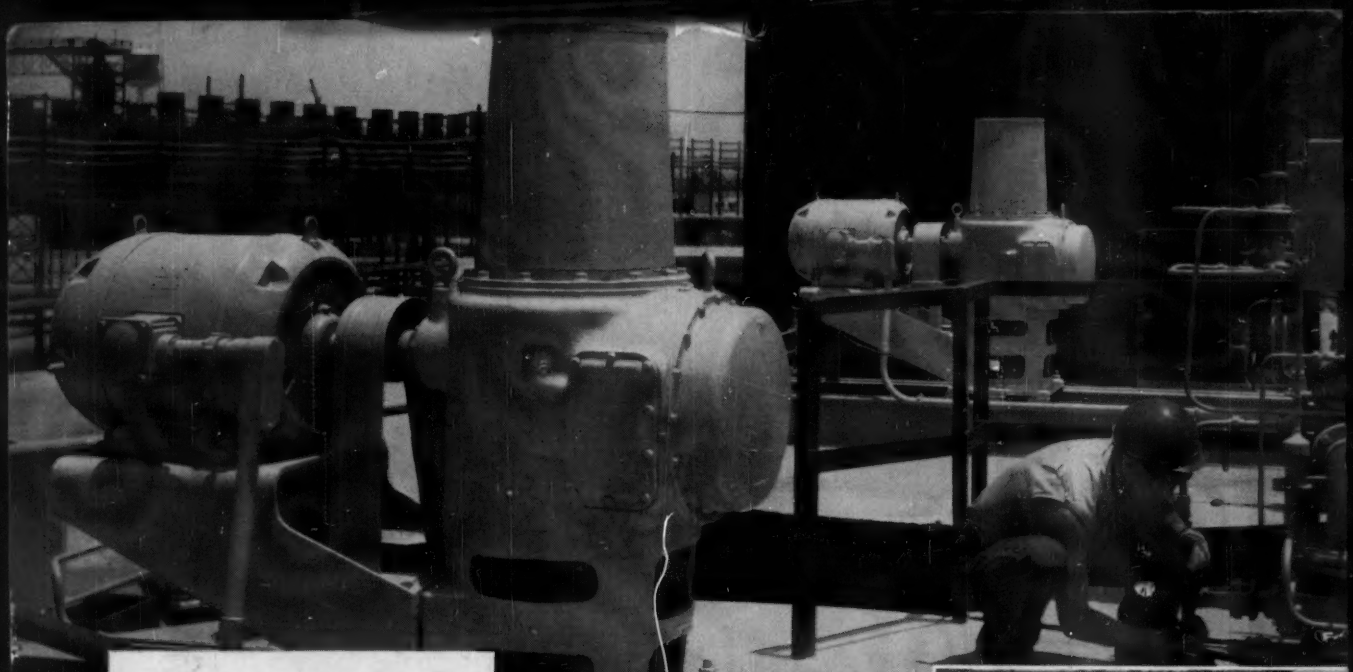


"With a normal preventative maintenance program, repair costs have been at a minimum." That's Dow Chemical Company's report on these 25-HP LIGHTNIN Mixers installed at Freeport, Texas.

PRIOR TO PURIFICATION, caustic is kept at uniform temperature, with help of mixing, in each of six 30,000-gallon tanks like these. LIGHTNINs also suspend sediment uniformly for easier removal.

How Dow holds mixing costs in line

Take a look at the size of Dow Chemical Company's Freeport, Texas, caustic soda plant—and you'll see why low operating costs for mixing equipment are vital.

No special research had to be done to determine what size mixers would handle this job best. Mixers were selected on the basis of unique pilot-run data on tap at MIXCO. Mixing results were fully predictable, and unconditionally guaranteed.

No steady bearings

Despite the 20-foot depth of the six 30,000-gallon tanks, there is no need for submerged bottom bearings on the shafts. Critical-speed data at MIXCO permitted accurate specification of overhung shafts adequately sized for the job, but not oversized.

A big factor in keeping maintenance cost down was the material specified for shafts and impellers—solid nickel. Engineers could freely select the best material for the job, because LIGHTNINs are available in any machinable alloy and with a wide choice of coverings.

On installation, substantial savings resulted from delivery of the LIGHTNINs fully assembled and aligned, ready to mount on the tanks without special construction.

Get these 3 vital savings

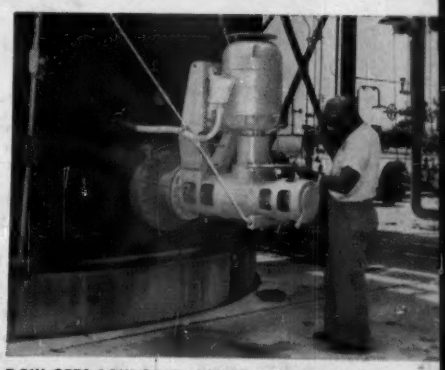
These economies are yours, too, when you choose LIGHTNINs for your fluid mixing operations.

You save design time with application data that's guaranteed accurate.

You save installation time because every LIGHTNIN reaches you as a "package," ready to install and run.

You keep saving on upkeep, with a host of mechanical features that minimize your service costs.

To get these savings for your processing, call in your LIGHTNIN Mixer representative. He's listed in Chemical Engineering Catalog. Or write us direct.



DOW GETS LOW-COST MIXING in this 75,000-gallon caustic tank with a 25-HP side-entering LIGHTNIN. Stuffing box can be repacked simply and quickly. To seal off tank fluids for repacking, maintenance man turns easy-to-get-at handles at outboard end of mixer.

What Mixing Operations are important to you? You'll find a wealth of information on fluid mixing in these helpful bulletins describing LIGHTNIN Mixers:

- ☐ Top or bottom entering; turbine, paddle, and propeller types: 1 to 500 HP (B-102)
- ☐ Top entering; propeller types: ¼ to 3 HP (B-103)
- ☐ Portable: ⅛ to 3 HP (B-108)
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- ☐ LIGHTNIN CM Contactor for continuous processing (B-515)
- ☐ Confidential data sheet for figuring your mixer requirements (B-107)

Check, clip and mail with your name, title, company address to:

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In Canada: Greey Mixing Equipment, Ltd., 100 Miranda Avenue, Toronto 19, Ont.

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